NASA Langley Research Center

ENVIRONMENTAL RESOURCES DOCUMENT

CY 2001 Update

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NASA Langley Project Officer:

Robert D. Brown
Environmental Management Office
MS 418
NASA Langley Research Center
Hampton, VA 23681-2199

SAIC Project Officer:

Kristen K. Poultney
Science Applications International Corporation
22 Enterprise Parkway, Suite 200
Hampton, VA 23666

TABLE OF CONTENTS

LIST OF ACRONYMS

ACBM	Asbestos-Containing Building Materials
ACHP	Advisory Council on Historic Preservation
ACM	Asbestos-Containing Materials
ACOE	U.S. Army Corps of Engineers
AQCR	Air Quality Control Region
ARU	Anti-freeze Recycling Unit
AST	Aboveground Storage Tank
atm	Atmosphere
AWQC	Ambient Water Quality Criteria
BOD	Biochemical Oxygen Demand
bps	Bytes Per Second
BTU	British Thermal Unit
C	Centigrade or Celsius
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CBX	Computerized Branch Exchange
CDL	Construction Debris Landfill
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFCs	Chlorofluorocarbons
cm	Centimeter
CO	Carbon Monoxide
C&P	Chesapeake and Potomac
cu	Cubic
CWA	Clean Water Act
CZMA	Coastal Zone Management Act of 1972
DACS	Department of Agriculture and Consumer Services
dBA	Decibels, A-weighted Scale
DCR	Department of Conservation and Recreation
DDTR	DDT and Related Compounds
DGIF	Department of Game and Inland Fisheries
DOD	Department of Defense
DOT	Department of Transportation
DRMO	Defense Reutilization and Marketing Office
dscf	Dry Standard Cubic Feet
EA	Environmental Assessment
EAP	Employee Assistance Program
EIS	Environmental Impact Statement
EMP	Environmental Management Office
EPA	Environmental Protection Agency
EPA Form R	EPA Toxic Chemical Release Inventory Form
EPCRA	Emergency Planning and Community Right-to-Know Act
ERD	Environmental Resources Document
F	Fahrenheit
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Administration
FFCA	Federal Facility Compliance Agreement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
ft	Foot, Feet
FWPCA	Federal Water Pollution Control Act
gal	Gallon
gr	Grain
GSA	General Services Administration
GTEM	Gigahertz Transverse Electromagnetic
HAPs	Hazardous Air Pollutants
HCS	Hazard Communication Standard
hp	Horsepower
hr	Hour
HRS	Hazard Ranking System
HRSD	Hampton Roads Sanitation District
HSWA	Hazardous and Solid Waste Amendments of 1984
HVAC	Heating, Ventilating, Air Conditioning
ICUZ	Installation Compatible Use Zone
in	Inch
IPM	Integrated Pest Management
K	Thousand
kV	Kilovolt
kWh	Kilowatthour
l	Liter
LAFB	Langley Air Force Base
LaRC	Langley Research Center
LATS	Langley Telecommunication System
lb	Pound
LEMS	Lunar Excursion Module Simulator
LEPC	Local Emergency Planning Commission
LMAL	Langley Memorial Aeronautical Laboratory
M	Million
m	Meter
Mbps	Megabytes Per Second
mCi	Millicurie
MCLs	Maximum Contaminant Levels
MeV	Megaelectronvolt
MF	Multiple-tube Fermentation
mg	Milligram
MHz	Megahertz
mi	Mile
ml	Milliliter
MLB	MLB Enterprises
MOA	Memorandum of Agreement
mph	Miles Per Hour

LIST OF ACRONYMS (continued)

MPN	Most Probable Number
MSA	Metropolitan Statistical Area
MSDS	Material Safety Data Sheet
MSL	Mean Sea Level
MW	Megawatt
NACA	National Advisory Committee for Aeronautics
NASA	National Aeronautics and Space Administration
NCO	Non-Commissioned Officer
NCSHPO	National Conference of State Historic Preservation Officers
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
ng	Nanogram
NHL	National Historic Landmarks
NHPA	National Historic Preservation Act
Nm^3	Normal Cubic Meter
NMFS	National Marine Fisheries Service
NMI	NASA Management Instruction
NO_2	Nitrogen Dioxide
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NSR	New Source Review
NWI	National Wetland Inventory
O&M	Operations and Maintenance
ODC	Ozone-Depleting Chemical
ODU	Old Dominion University
ODU-AMRL	Old Dominion University - Applied Marine Research Laboratory
OHSO	Occupational Health Services Office
OSD	Operations Support Division
OSEM	Office of Security and Environmental Management
OSHA	Occupational Safety and Health Administration
O_3	Ozone
PA	Preliminary Assessment
Pb	Lead
PCBs	Polychlorinated Biphenyls
PCTs	Polychlorinated Triphenyls
PIV	Particle Image Velocimetry
PMOA	Programmatic Memorandum of Agreement
PM-10	Particulates Smaller Than 10 Parts Per Million
ppm	Parts Per Million
PSD	Prevention of Significant Deterioration
psi	Pounds Per Square Inch
PWS	Public Water Systems
RCRA	Resource Conservation and Recovery Act
R&D	Research and Development
REC	Record of Environmental Consideration
RFSGF	Refuse-Fired Steam-Generating Facility
RPA	Resource Protection Areas
RSO	Radiation Safety Officer
RSS	Rain Simulation System
SAA	Satellite Accumulation Area
SARA	Superfund Amendment and Reauthorization Act
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
sec	Second
SERC	State Environmental Review Committee
SHPO	State Historic Preservation Officer
SI	Site Inspection
SIPs	State Implementation Plans
SO_2	Sulfur Dioxide
SPCC	Spill Prevention, Control, and Countermeasure
SVOC	Semi-Volatile Organic Compounds
SWDA	Solid Waste Disposal Act
TOC	Total Organic Compound
TPQ	Threshold Planning Quantity
TSCA	Toxic Substances Control Act
TSP	Total Suspended Particulate
UCS	Utility Control System
USAF	U.S. Air Force
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	Underground Storage Tank
VAC	Virginia Administrative Code
VCRMP	Virginia Coastal Resources Management Program
VDEQ	Virginia Department of Environmental Quality
VMRC	Virginia Marine Resources Commission
VOCs	Volatile Organic Compounds
VPCA	Virginia Pesticide Control Act
VPDES	Virginia Pollutant Discharge Elimination System
µm	Micrometer
$\mu g/m^3$	Microgram Per Cubic Meter

LIST OF APPENDICES

LIST OF EXHIBITS

LIST OF FIGURES

LIST OF TABLES

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PREFACE

PURPOSE

The National Environmental Policy Act (NEPA) of 1969, Public Law 91-190, requires that all Federal agencies consider the environmental effects of proposed actions. The Act also specifies that Federal agencies shall adopt both administrative regulations and policies and procedures to ensure decisions are made in accordance with the provisions of NEPA. The regulations that Federal agencies must follow when implementing NEPA are prepared by the Council on Environmental Quality (CEQ) and published at 40 CFR Parts 1500-1508.

NASA has developed agency-specific guidance in accordance with the CEQ regulations. The policies and procedures are published at 14 CFR Part 1216. Although not required by NEPA or CEQ regulations, NASA mandates the preparation of a resource document as follows:

> Each Field Installation Director shall ensure that there exists an environmental resources document which describes the current environment at that field installation, including current information on the effects of NASA operations on the local environment. This document shall include information on the same environmental effects as included in an environmental impact statement (see 14 CFR 1216.307). This document shall be coordinated with the Associate Administrator for Management and shall be published in an appropriate NASA report category for use as a reference document in preparing other environmental documents. [14 CFR 1216.319]

Additional guidance on NASA NEPA policy can be found in NPG 8840.X, "NASA Procedures and Guidelines for Implementation of the National Environmental Policy Act, and NPD 8500.1, "NASA Environmental Management."

The ERD provides the current status and a description of the different environmental areas and operations at the Center. The document serves as a baseline against which the effects of proposed actions can be judged to determine a possible environmental impact.

LANGLEY RESEARCH CENTER ENVIRONMENTAL PROGRAM

The Center's environmental policy is contained in the LaRC Environmental Program Manual, LAPG 8800.1. The manual describes policies, procedures and responsibilities for each environmental program area, such as air, water, and NEPA. The manual is available electronically at: http://ldms.larc.nasa.gov/h8800-1a.pdf or by contacting the Environmental Management Office at ext. 43500.

The Center's environmental policy is "to comply with all applicable Federal, State, and local environmental regulations. In situations involving non-compliance, LaRC will take immediate corrective action order to achieve compliance. LaRC seeks to minimize

pollution whenever feasible. LaRC has a policy of continuous process improvement to assure responsible environmental stewardship consistent with Center goals and objectives."

The Environmental Management Office (EMO) manages the environmental program and environmental compliance at LaRC. The government staff is supported by an on-site environmental contractor, and Facility Environmental Coordinators (FECs) are assigned by Division Heads to assist in program administration at the facility level.

The EMO is responsible for obtaining and maintaining the Center's environmental permits. The permits currently in effect governing operations at LaRC are for air emissions and water discharges. These permits are detailed in Sections 2 and 3, respectively of this document.

The Center frequently undergoes both internal and external environmental audits and inspections. All onsite regulatory reviews are coordinated through the EMO with minimum impact to Center operations. The Virginia Department of Environmental Quality (VDEQ) typically conducts annual audits at the Center in the areas of air emissions, water discharge, and hazardous waste. The Hampton Roads Sanitation District (HRSD) performs a semi-annual audit of the Center's sanitary sewer discharge system.

The EMO frequently conducts multimedia environmental assessments of all LaRC facilities. These assessments are to ensure that the facilities and their operations are in compliance with the Center's environmental policies. The EMO maintains records of assessment results and follow up inspections.

ENVIRONMENTAL RESOURCE DOCUMENT ORGANIZATION

This document is organized into sixteen chapters according to the various environmental aspects or media related to the Center. Appendices, exhibits, figures and tables are included to provide additional information as needed.

Most chapters have the following structure:

> *Regulatory Background* – Review of applicable regulations, Executive Orders, and other guidance as they relate to the chapter subject at LaRC. Both Federal and State information may be included.
>
> *Langley Research Center Operations* – Review of regulatory compliance and how LaRC operations potentially affect the chapter subject.
>
> *Major Environmental Concerns for Proposed Actions* – Provides guidance and procedures to be followed in the event that a proposed action could possibly have an environmental impact on the subject media.

Copies of the LaRC Environmental Resource Document are maintained by the EMO and are available by calling ext. 43500.

1.0 DESCRIPTION OF CENTER

1.1 LOCATION

The National Aeronautics and Space Administration Langley Research Center (LaRC) is located in the northeastern portion of the City of Hampton, Virginia. The Center is situated near the southern end of the lower Virginia Peninsula, approximately 150 miles south of Washington D.C. and 50 miles southeast of Richmond, Virginia.

LaRC occupies 808 acres of federal government-owned land in Hampton. The majority of LaRC facilities are located on the West Area, 788 acres of land to the west of Langley Air Force Base (LAFB). The West Area is bound by the Brick Kiln Creek to the north, State Route 172 to the west, and LAFB to the south and east. The East Area is an additional 20-acre area occupied by LaRC, situated on LAFB property and separated from the West Area by the runway facilities of LAFB. Approximately 220 buildings are divided between the two areas, the majority of which are located in the West Area. Figure 1-1 shows the location of LaRC and its surroundings. Figures 1-2 and 1-3 are overview maps of the LaRC West and East Areas.

LaRC is located in close proximity to several surface water bodies within the tidal zone of the Chesapeake Bay. The cities of Hampton, Poquoson, Newport News, and Williamsburg as well as York County form a major metropolitan statistical area (MSA) surrounding LaRC.

1.2 FACILITY BACKGROUND

LaRC had its beginnings in 1917 when the War Department purchased land in Elizabeth City County (now Hampton, Virginia) for the joint use of the Army and the National Advisory Committee for Aeronautics (NACA), the forerunner organization of NASA. NACA was created to supervise and direct the scientific study of the problems of flight, with a view to practical solutions. Langley Field, authorized in 1917, was built as a joint experimental airfield and proving ground for aircraft. It was named after Professor Samuel Pierpont Langley, an early pioneer in flight. With the dedication of the first wind tunnel in 1920, the facility was renamed Langley Memorial Aeronautical Laboratory. When NASA succeeded NACA in 1958, the Langley Laboratory was officially designated the Langley Research Center.

The mission of LaRC is to increase the knowledge and capability of the United States in the fields of aeronautical research and atmospheric science and in selected areas of space research. This mission is accomplished by performing innovative research relevant to national needs and NASA goals, transferring technology to users in a timely manner, and providing development support to other United States government agencies, industry, and other NASA centers.

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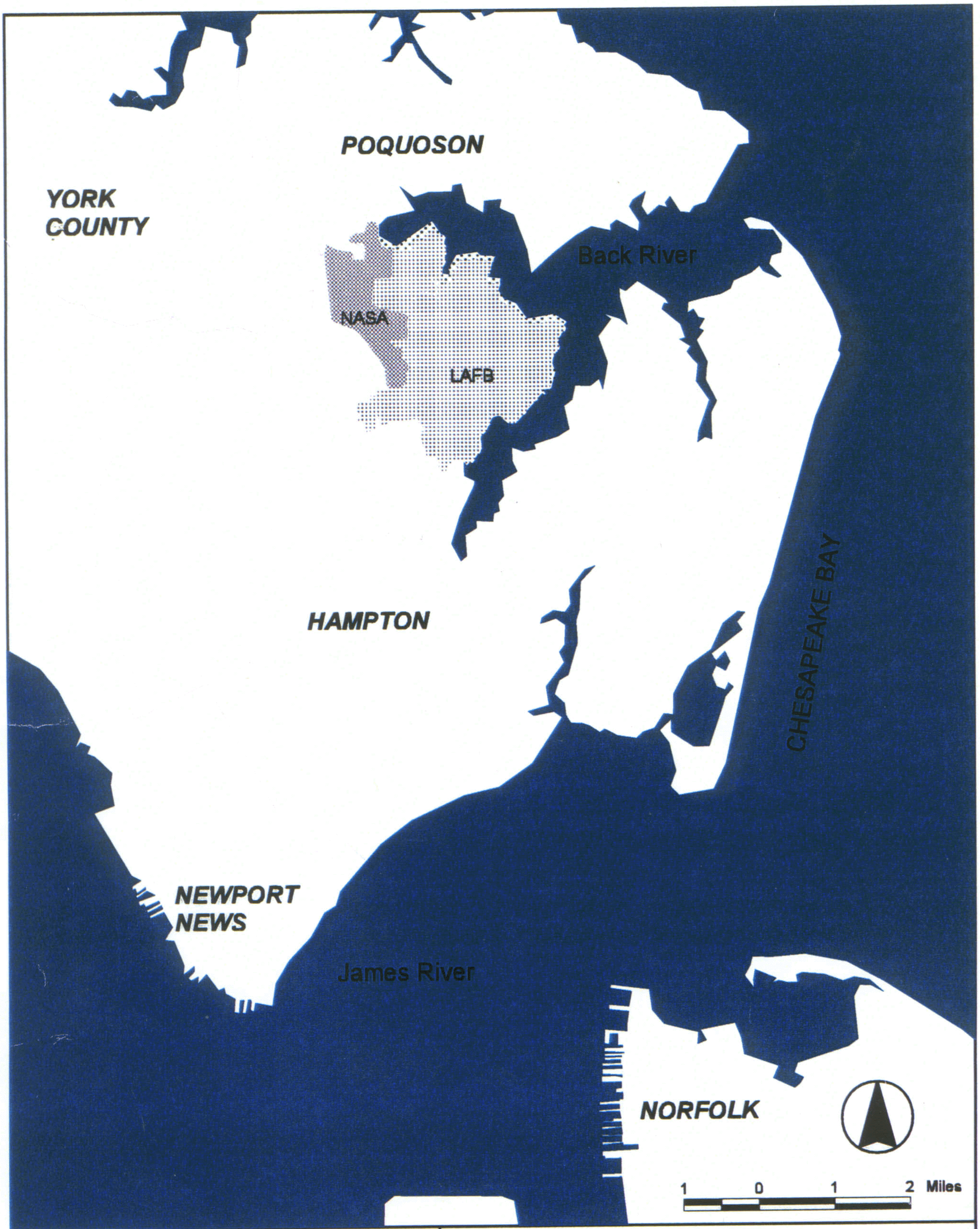
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MD
VA
Created by NASA LaRC GIS Team
April, 1999
NASA
National Aeronautics and Space Administration
Langley Research Center
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Figure 1-1 Vicinity Map

NORTH

LEGEND

- Not Classified
- Wind Tunnel
- Flight Research Facility
- Computational Facility
- Laboratories/Offices
- Shops-Heavy Support
- Shops-Electronic or Light
- Office Facilities-Research/ Engineering/Support
- Community/Conference Facilities
- Warehousing/Storage
- Miscellaneous/Special facilities not otherwise coded

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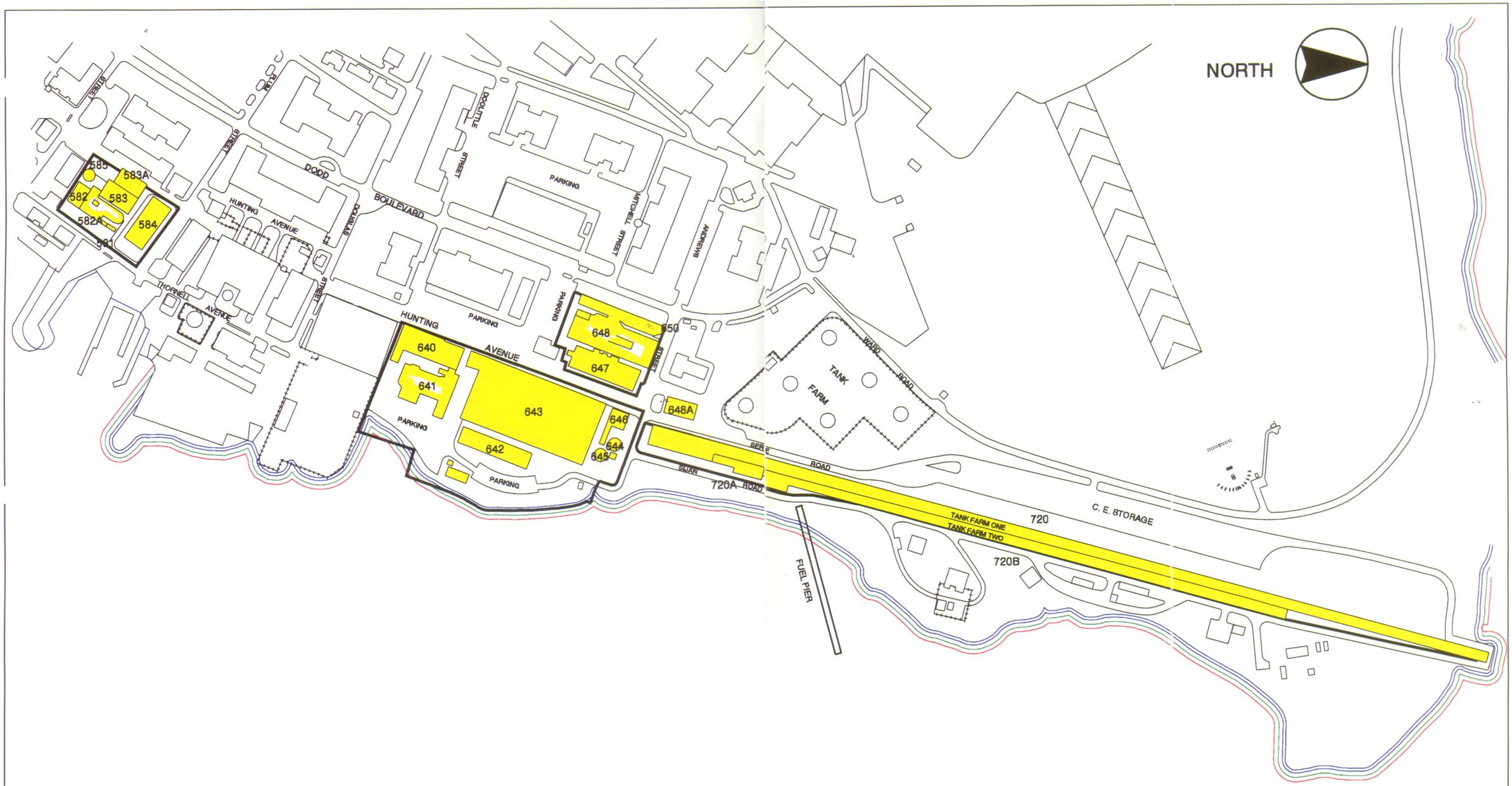
National Aeronautics and Space Administration
Langley Research Center

Environmental Resources Document

LaRC West Area Overview Map



LEGEND

NASA Facilities

Air Force Facilities

500 1000 1500 FT.

National Aeronautics and Space Administration
Langley Research Center

Environmental Resources Document

LaRC East Area Overview Map

To fulfill its mission, LaRC employs approximately 3,770 individuals including administrators, researchers, technicians, maintenance staff, and on-site contractors. The Center is organized into groups and divisions based on current research and development areas. The most recent organizational chart for the Center can be found at the Langley Management System web site at http://lms.larc.nasa.gov. Table 1-1 describes the major research and support facilities located at LaRC.

Seventy percent of the work at LaRC is aeronautical research related, which includes improving today's aircraft and developing concepts and technology for aircraft of the future. The aeronautical research goals of the Center are to: (1) develop technologies that enable aircraft to fly faster, farther, and safer, and (2) make it possible for these aircraft to be more maneuverable, quieter, less expensive, and more energy-efficient. LaRC uses wind tunnels, computer modeling, and other facilities and techniques to conduct tests and research on aircraft.

The remaining thirty percent of the work at LaRC supports atmospheric science and national space programs. Researchers identify and develop technology for advanced space transportation systems, conduct advanced concept studies for space, and conduct studies in atmospheric and earth sciences. LaRC researchers also study composite materials, structures, thermal guidance control systems, electronic systems, and robotics.

1.3 TENANT ORGANIZATIONS WITHIN LaRC

In addition to NASA and its support contractors, there are resident Federal, State, and support agencies at LaRC. These agencies are listed in Table 1-2.

Table 1-1 MAJOR FACILITIES IN LARC		
Building No.	Building Designation	Facility Description
582A	Low-Turbulence Pressure Tunnel	Closed-circuit, single-return wind tunnel used for basic aerodynamic research; operates between near-vacuum and 10 atm pressure and Mach number 0.05 to 0.5; test medium is air; drive system is 2,000 hp direct current motor.
644	12-Foot Low Speed Tunnel	Wind tunnel used as a free flight tunnel.
645	20-Foot Vertical Spin Tunnel	The only operational spin tunnel in the Western Hemisphere; used to conduct spin and tumbling research on aerospace vehicles, civil and military aircraft; test medium is air; main drive motor is rated at 400 hp for continuous operation and at 1,300 hp for short runs.
646	East Area Compressor Station	Compressor station to meet needs of up to 300 psi compressed air for East Area facilities.
648	Transonic Dynamics Tunnel Flutter and Aeroelasticity	Slotted-throat, single return, closed-circuit wind tunnel used for dynamic and aero-elasticity testing; test medium can be air or heavy gas (RP12); heavy gas is reclaimed and reused in operation; drive system is a 30,000 hp fan motor.
720	Basic Aerodynamics Research Tunnel	Flow diagnostic facility acquiring data required for investigating character of complex flow fields: open-return wind tunnel with closed test section.
1146 A-D	16-Foot Transonic Tunnel	Closed-circuit, single-return, continuous-flow atmospheric tunnel used for basic research; Mach numbers up to 1.3; test medium is air; main drive is 60,000 hp electrical motor; also has 36,000 hp compressor to provide suction capacity.
1148	Structures & Materials Laboratory	Supports a broad range of structural and materials development activities for advanced aircraft, aerospace vehicles, and space platform and antenna structures; houses a variety of material preparation and testing equipment using state-of-the-art electron and x-ray microscopy, laser technology, high-temperature ovens, and high-pressure inert-atmosphere furnaces.
1155	Photographic Lab	Provides photographic services for the Center.
1159	Pyrotechnic Test Facility Systems Envt Test Facility	Contains space simulation environmental and functional test equipment for handling and testing small-scale potentially hazardous materials.
1166	Central Hazardous Waste Storage Facility	90-day storage facility for hazardous wastes for off-site disposal.
1200	Advanced Technology Research Laboratory	Houses multi-disciplinary research activities assessing the feasibility of space laser power generation and long distance transmission for electric power distribution, conducting theoretical studies on galactic and solar cosmic ray exposure and shielding and developing ultra-high vacuum

Table 1-1 MAJOR FACILITIES IN LARC		
Building No.	Building Designation	Facility Description
		gas-surface interaction technology.
1202	Flight Electronic Lab	Electronics instrumentation and fabrication facility.
1205	Materials Research Laboratory	Houses experimental facilities for research characterizing structural materials behavior under application of mechanical and thermal loads. Liquid helium and liquid nitrogen are used.
1208	Acoustics Research Laboratory	Consists of anechoic quiet-flow facility, reverberation chamber, transmission loss apparatus and human-response-to-noise laboratories. Anechoic quiet-flow facility has test flow varying in Mach number up to 0.5.
1212	13-Inch Magnetic Suspension Laboratory	Wind-Tunnel testing laboratory with combination magnetic suspension and balance system providing lift force, pitching moment, side force, and yawing moment. Continuous-flow, closed-throat, open circuit tunnel design capable of speeds up to Mach 0.5.
1212B	7 x 10-Foot High-Speed Tunnel	Closed circuit, single-return, continuous-flow atmospheric tunnel with solid-wall test section. Tunnel is fan-driven, powered by 14,000 hp electric motor, and operates with Mach number range from 0.2 to 0.9.
1212C	14 x 22-foot Subsonic Tunnel	Tunnel used for low-speed testing of powered and unpowered models of aircraft; is powered by 8,000 hp electrical drive system, providing precise tunnel speed control. Tunnel can be operated as closed tunnel or as one or more open configurations.
1215	West Area Steam Plant	Provides steam for the West Area facilities for process use and heating. The plant has 4 boilers: a new 66 MBtu natural gas-fired boiler; a 120 MBtu dual-fired natural gas and #2 fuel oil boiler; and two 168 MBtu dual-fired natural gas and #2 fuel oil boilers. The plant provides about 20 percent of LaRC steam requirement.
1220	Avionics Integration Research Laboratory	Environmentally controlled structure housing numerous microcomputer and minicomputer resources and special fault-tolerant research hardware test specimens. Research activities encompass identifications and development of methods for validating and evaluating digital control and guidance systems for aerospace vehicles.
1221, 1221D	Hypersonic Propulsion Sys Scramjet Test Complex	Consists of four test facilities and a diagnostics laboratory for supersonic combustion ramjet (scramjet) engine research with simulated flight Mach number range from 3.4 to 8. Includes research program to develop technology for hydrogen-fueled scramjet propulsion system. Scramjet inlet design tests conducted in air and helium.

Table 1-1 MAJOR FACILITIES IN LARC		
Building No.	Building Designation	Facility Description
1221A	High Intensity Noise Facility	Laboratory for high-intensity and high frequency noise research.
1230	Instrument Research laboratory	Combination of research facilities concentrating on nondestructive evaluation materials measurement science for composites and metals. Research emphasis on materials characterization and ensuring materials integrity.
1232A	Aerospace Controls Research Laboratory	Research and testing activities for spacecraft control systems. Equipped with microcomputer facilities for simulations data acquisition, and real-time control system testing. Provides controls community with facilities with which performance of competing control laws may be compared.
1234	Jet Exit Test Facility	Used for flow visualization studies.
1236	National Transonic Facility	A fan-driven, closed-circuit, continuous-flow, pressurized wind tunnel with slotted-wall configuration. Test gas may be dry air or nitrogen. Heat removal is by water-cooled heat exchange or evaporation of liquid nitrogen sprayed into the fan. When nitrogen is injected, venting occurs to maintain constant pressure.
1237A	Foundry/Glass Blowing Lab	A metalworking foundry and a glass-blowing laboratory.
1237B	Electronics Fabrication and Development Laboratory	Facility for developing and fabricating electronic components.
1237C	Glass-Blowing Laboratory	Facility for grinding and polishing of glass and ceramics.
1238	Electronics Technology Lab	Facility for fabrication of electronics instrumentation.
1242	0.3M Transonic Cryogenic Tunnel	A three-dimensional, continuously operating, cryogenic pressure tunnel with stagnation pressure varying from 1 bar to 6 bars and stagnation temperature from 340 K to approximately 77 K (-196 C). Test gas is nitrogen.
1244	Flight Research Facility	Truss-supported hangar providing over 87,000 square feet (8,083 square meters) of clear floor space. Features floor air and electrical power services, radiant floor heating, and fire suppression system to accommodate maintenance, repair, and modification of aircraft.
1247B 1247D 1251A 1275	Hypersonic Facilities Complex	Consists of several hypersonic wind tunnels located at four sites. Represents major resource for wind-tunnel testing used to study the aerodynamic and aero-thermodynamic phenomena associated with advance space transportation systems. Provides capability to study effects of Mach number, Reynolds number, test gas, and viscous interaction on hypersonic characteristics of

Table 1-1 MAJOR FACILITIES IN LARC		
Building No.	Building Designation	Facility Description
		aerospace vehicles.
1247E	West Area Compressor Station	Provides compressed air for West Area facilities.
1247H	High Reynolds Number Helium Tunnel	Wind tunnel for high-speed flight research.
1250 1295	Space Simulation and Environmental Test Complex	The 60-ft-diameter Space Simulation Sphere (Building 1295) can simulate an altitude of 320,000 feet (97,536 meters). Vacuum level attainable with three-stage pumping system. Thermal-vacuum chamber (Building 1250) includes two 35-inch cryogenic pumps to accommodate chamber temperatures of -300°F to 1,000°F (-184°C to 538°C). A completely enclosed liquid-nitrogen cryo-panel can cool ambient temperature to -300°F (184°C).
1251 A-E	Unitary Wind Tunnel	A closed-circuit, continuous-flow, variable-density tunnel with a test section range of Mach 1.5 to 4.6 used to study force and moment pressure distribution, jet effects, dynamic stability, and heat-transfer studies.
1256 1160	Combined Loads Test System (COLTS)	The Combined Loads Test Machine has the capability of testing fuselage barrel sections with diameters up to 15 feet and length up to 45 feet. It also has the capability of testing fuselage panels by use of a test fixture called the D-Box. The Building 1160 Complex houses the Pressure Box Test Machine and the Cryogenic Pressure Box. Both of these test machines are used to test fuselage panels in biaxial tension.
1257	Aircraft Landing Dynamics Facility	Capability for testing of wheels, tires, and advanced landing systems. Includes a Rain Simulation System (RSS), a wide overhead distribution system of parallel irrigation pipes capable of simulating rainfall intensities up to 40 in/hr (102 cm/hr) or virtually any runway surface and weather condition.
1258	Landing Loads Compressor and Control Building	Support facilities for the Aircraft Landing Dynamics Facility.
1265A-E	8-Foot-High Temperature Tunnel	Consists of four facilities used to conduct research in aero-thermal loads and high-temperature structures and thermal protection systems.
1267	Thermal Structures Lab	High temperature materials research laboratory.
1268A	Flight Simulation Laboratory Computer Complex	Visual motion simulator facility and associated computer complex for flights of various aircraft types.

Table 1-1 MAJOR FACILITIES IN LARC		
Building No.	Building Designation	Facility Description
1268B	Data Reduction Center Computer Complex	Center scientific computing facility.
1271	Engineering Support Lab #2	Open-shed machine shops for support activities.
1293A	Polymeric Materials Laboratory	Laboratory complex provides 25,000 square feet (2,323 square meters) for the synthesis and characterization of high-performance polymers, as well as development of processing technology and composite fabrication.
1293B	Structural Dynamics Laboratory	Designed to conduct research on the dynamics and controls behavior of spacecraft and aircraft structures, equipment and materials; offers environmental simulation capabilities, including acceleration, vacuum, and thermal radiation.
1297	Impact Dynamics Research Facility	Facility used to simulate crashes of full-scale aircraft under controlled conditions. Aircraft are swung by cables, pendulum-style, into concrete impact runway from an A-frame structure. Impact runway can be modified to simulate other ground crash environments.
1298	Guidance and Control Research Laboratory	Primary testing facility for concepts and devices emerging from cockpit electronic control research program. Flight simulation environment provides full range of ambient and solar lighting conditions to be encountered by a cockpit. Simulator used to study adverse effects upon display media.
1299	Flight Electronics Laboratory	Research facility used to obtain data for new antenna performance and electromagnetic scattering data. Consists of two indoor radio frequency anechoic test chambers and an outdoor antenna range system which includes two remote transmitting towers.
Source: LaRC 2000		

Table 1-2
TENANT ORGANIZATIONS AT LANGLEY RESEARCH CENTER

Building No.	Building Designation	Agency	Facility Description/Use
	AGATE Alliance Association, Inc. (AAAI)		Administrative Offices
1146	Center for Advanced Computational Technology / 16-Foot Transonic Tunnel	University of VA	Research & Development
1149	Audits - Aeronautics and Space Transportation	Office of Inspector General	Administrative Offices
1149	Inspections and Assessments	Office of Inspector General	Administrative Offices
1149	Investigations	Office of Inspector General	Administrative Offices
1152	ICASE	Inst. for Computer Applications in Sci. & Eng.	Administrative Offices
1229	Research & Development Field Office	Federal Aviation Administration	Hangar & Support Facilities
1231/ 1231B	Child Development Center	Langley Child Development Center	Child Development Center
1244	Joint Institute for Advancement of Flight Sciences	George Washington University	Administrative Offices
1244C	Hangar Offices	Joint Research Program Office, AFDD, AMCOM	Administrative Offices
1244C	Hangar Offices	U.S. Army Vehicle Technology Center, ARL	Administrative Offices
1288	Refuse-Fired Steam-Generating Facility	City of Hampton	Steam-Generating Facility
1312	LAFB Liaison Office	Air Force Liaison Office	Offices

Source: LaRC, 2001

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2.0 AIR RESOURCES

2.1 REGULATORY OVERVIEW

2.1.1 The Clean Air Act

The Clean Air Act of 1970 (CAA) was enacted by Congress to protect air quality in the United States. The CAA is implemented through air pollution laws administered and enforced by the U.S. Environmental Protection Agency (EPA). However the EPA has largely delegated the task of administering air pollution laws to the States. The State Air Pollution Control Board promulgates Virginia's air regulations. These regulations ensure that regulated facilities comply with federal requirements.

The Virginia Department of Environmental Quality (VDEQ) administers the requirements of the federal Clean Air Act in Virginia and enforces the State's air pollution laws and regulations. Virginia's air quality plans, called State Implementation Plans, must be reviewed and approved by EPA in order for the state to enforce the Clean Air Act. The Air Quality Plans set forth the actions to be taken to meet and maintain ambient air quality standards in Virginia and to prevent significant deterioration of air quality in areas that are currently cleaner than the standards. The EPA also requires that the State implement an adequate system of enforcing air pollution regulations.

The CAA established the National Ambient Air Quality Standards (NAAQS). These standards limit the concentrations of certain pollutants in the ambient air. The limits set for these pollutants, called criteria air pollutants, include both primary and secondary limits or standards. Primary standards were established to protect the public's health and secondary standards were established to prevent environmental and property damage. Currently, there are six criteria pollutants limited by NAAQS: Carbon monoxide (CO), Nitrogen dioxide (NO_2), Ozone, (O_3), Particulate matter (PM), Sulfur oxides (measured as SO_2), and Lead (Pb). These pollutants are regulated under the Virginia Air Pollution Control Law and the Regulations for the Control and Abatement of Air Pollution.

The CAA also set the National Emissions Standards for Hazardous Air Pollutants (NESHAP) and these pollutants are regulated by the state. The NESHAP regulations cover eight pollutants - arsenic, asbestos, benzene, beryllium, mercury, radionuclides, radon, and vinyl chloride. The regulation was established to protect public health by setting emission standards for these pollutants.

The CAA also requires New Source Performance Standards for stationary sources. This means that any new air pollution source must install appropriate air pollution control for that industry. Two of the goals of the CAA are to maintain ambient air quality in areas that already meet air quality standards (attainment areas) and to reach attainment in areas that do not currently meet the standards (non-attainment areas). In order to meet the CAA goals, Virginia regulates both new and existing air pollution sources through federal and state permitting programs.

In 1990, Congress passed the Clean Air Act Amendments (CAAA). The amendments expanded the previous eight NESHAP pollutants to include 189 toxic compounds called Hazardous Air Pollutants (HAPs). The list of HAPs is shown in Appendix II-1.

While NESHAPs were based on health considerations, the new HAPs regulations are based on available control technology. Maximum Available Control Technology (MACT) Standards were established for certain categories of sources and include specific emission standards and requirements for control technology for these 189 pollutants.

2.1.2 Air Permits

The air permit system is the method used to monitor compliance and enforce air pollution laws and regulations. The CAAA established a permit program for large sources that release pollutants into the air. The national permit system mandated by the EPA is called the Title V Operating Permit Program. Under this program, air permits are issued by the state, or if the state fails to carry out the Clean Air Act satisfactorily, by the EPA. The essential concepts of the air permitting system include:

Potential to Emit - Potential to emit is the maximum physical and operational capacity of a source to emit any air pollutant. This potential is based on year-round, day-and-night operation, but it takes into account federally enforceable restrictions and controls on the facility. It does not take into account voluntary limits or state controls.

Applicable Requirements - Both the state and federal operating permit programs serve as vehicles for identifying all requirements applicable to a source. These can include compliance, record keeping, reporting, emission controls, emission limits, work practices, operating hours, and other matters stemming from federal and state air laws and regulations as well as permits for constructing or modifying a facility.

Synthetic Minors and Potential to Emit - A source can avoid the requirements of a Title V permit if it can keep its potential to emit below the thresholds in the Title V definition of a major source. Synthetic minor sources agree to abide by emissions or operational limits that keep the source below the major threshold. A synthetic minor source will not be a Title V major source as long as the emission limits are enforceable through the state operating or modified source permits.

The Virginia Department of Environmental Quality administers the state's air Operating Permit Program. The goal of the Operating Permit Program is to require every facility to have one comprehensive permit for all air pollution sources in that facility. The permit includes information on which pollutants are being released, how much may be released, and what steps are being taken to reduce emissions, including the monitoring of air emissions.

2.1.3 Hampton Roads Air Quality Control

The Hampton Roads Intra-State Air Quality Control Region (AQCR) is currently designated as an attainment area for all of the criteria pollutants. This attainment status was achieved for ozone during the summer of 1997, after the region accumulated three years of readings without violations.

EPA issued a new ozone standard in 1997. The new eight hour standard of 0.08 ppm has a longer averaging period, which reflects new health research that says longer exposures to lower levels of ozone can be just as detrimental as shorter term exposures to higher levels of ozone.

2.1.4 Ozone Depleting Compounds

The CAAA established a deadline of 2000 for the phaseout of the production of the Class I Ozone Depleting Compounds (ODCs) chlorofluorocarbons (CFCs), halons, and carbon tetrachloride, and 2002 for methyl chloroform. In 1992, these deadlines were accelerated in response to scientific findings that significant ozone depletion is underway in the Northern Hemisphere. The accelerated schedule required the phaseout of Class I ODCs by December 31, 1995. Also in 1992, the United States and other parties to the Montreal Protocol agreed to accelerate the phaseout of CFCs, carbon tetrachloride and methyl chloroform to the end of 1995 and halons to the end of 1993. Under the Montreal Protocol, the U.S. must also phaseout its use of Class II ODCs (hydrochlorofluorocarbons or HCFCs) by 2030.

In 1993, Executive Order 12843 directed Federal agencies to minimize the procurement of products containing Ozone-Depleting Substances (ODS). NASA issued NPG 8820.3 in response to the Executive Order. The NASA policy requires that NASA minimize the procurement of Ozone-Depleting Substances in anticipation of the phaseout of ODS production. In April 2000, Executive Order 13148 was issued. This new Executive Order directs federal agencies to develop a plan by April 2001 to phase out the procurement of Class I ODS for all nonexcepted uses by December 31, 2010.

Executive Order 13148 also requires federal agencies to ensure that its facilities: (1) maximize the use of safe alternatives to Ozone-Depleting Substances, as approved by the EPA's Significant New Alternatives Policy (SNAP) program; (2) evaluate the present and future uses of Ozone-Depleting Substances, including making assessments of existing and future needs for such materials, and evaluate use of, and plans for recycling, refrigerants, and halons; and (3) exercise leadership, develop exemplary practices, and disseminate information on successful efforts in phasing out Ozone-Depleting Substances.

2.2 NASA LANGLEY OPERATIONS

2.2.1 Regional Ambient Air Quality Monitoring

A summary of the regional ambient air concentrations of pollutants for calendar year 1999 is included in Table 2-1. The table lists the National Primary and Secondary Standards for ambient air quality and shows the observed ambient air concentration of criteria pollutants in the NASA LaRC area for calendar year 2000.

Table 2-1
AMBIENT AIR QUALITY STANDARDS AND OBSERVED
AMBIENT CONCENTRATIONS FOR NASA LARC AREA

Pollutant	National Primary Standard	National Secondary Standard	Observed Ambient Concentration (2000)
Suspended Particulate Matter <10μm Annual Arithmetic Mean 24-hour Average	 50 $\mu g/m^3$ 150 $\mu g/m^3$	 50 $\mu g/m^3$ 150 $\mu g/m^3$	 20.4 $\mu g/m^3$ (H) 41 $\mu g/m^3$ max (H)
Suspended Particulate Matter <2.5μm Annual Arithmetic Mean 24-hour Average*	 15 $\mu g/m^3$ 65 $\mu g/m^3$	 15 $\mu g/m^3$ 65 $\mu g/m^3$	 None yet None yet
Sulfur dioxide Annual Arithmetic Mean 24-hour Average 3-hour Maximum	 0.03 ppm 0.14 ppm None	 None None 0.50 ppm	 0.005 ppm (H) 0.017 ppm max (H) Not reported
Carbon Monoxide 8-hour Average 1-hour Average	 9 ppm 35 ppm	 None None	 2.4 ppm max (H) 4.7 ppm max (H)
Nitrogen dioxide Annual Arithmetic Mean	 0.053 ppm	 0.053 ppm	 0.016 ppm (N)
Ozone 1-hour Average 8-hour Average*	 0.12 ppm 0.08 ppm	 0.12 ppm 0.08 ppm	 0.094 ppm max (H) None yet
Lead Quarterly Average	 1.5 $\mu g/m^3$	 1.5 $\mu g/m^3$	 Not reported

Notes: ppm = parts per million, $\mu g/m^3$ = micrograms per cubic meter.
Most ambient standards are not to be exceeded more than once per year, but some require more complex averaging procedures. Values given are for nearest monitoring station to LaRC. Abbreviations are Hampton (H) and Norfolk (N).
*The new Particulate Matter 2.5 and 8-hour Ozone standards have not yet been implemented by the the EPA.

Source: EPA AIRS Database Monitoring Reports, May 2001

The Virginia VDEQ maintains an air quality monitoring station at the Virginia School for the Deaf and Blind at 700 Shell Road in Hampton. This monitoring station is located approximately 6 miles southwest of NASA LaRC. Air quality data for the City of Hampton are collected at this monitoring station and are reported to the U.S. EPA's Aerometric Information Retrieval System (AIRS). Table 2-2 shows the air quality

measured at the Hampton monitoring site and reported to AIRS for the past six years.

Table 2-2
HAMPTON AIR QUALITY
BASED ON THE POLLUTANT STANDARDS INDEX

YEAR	NUMBER OF DAYS REPORTED	PERCENT OF DAYS WHEN AIR QUALITY WAS...		
		GOOD	MODERATE	UNHEALTHFUL
1994	365	75	24	0
1995	365	78	22	0
1996	366	76	24	0
1997	365	77	23	0
1998	365	71	29	0
1999	365	78	21	1
2000	366	78	22	0

Source: EPA AIRS Database Pollutant Standards Index Reports, May 2001
http://www.epa.gov/airsdata/

2.2.2 LaRC's Air Permit

A Title V Federal Operating Permit is not required by the Center. LaRC qualifies as a synthetic minor because its air emissions are limited below the prescribed thresholds by its state operating permit. The major components of the Center's air permit are the Center-wide emissions limits, the air emissions sources regulated under the permit, and the conditions placed on these sources to ensure air emission limits are met.

The Center's air permit limits both emissions from individual air pollution sources and facility-wide emissions. Table 2-3 shows the Center's air pollutant emissions for calendar years 1999 and 2000 and the facility-wide permit emissions limits from the current air permit.

Table 2-3
CENTER EMISSION RATES AND PERMIT EMISSION LIMITS

Air Pollutant	Quantity Emitted 2000 (tons/yr)	Quantity Emitted 1999 (tons/yr)	Permit Emission Limits* (tons/yr)
Criteria Pollutants			
Carbon Monoxide	8.23	7.87	57.9
Nitrogen Oxides (as NO_2)	13.20	13.14	95.7
Particulate $Matter_{10}$	0.86	0.82	28.7
Sulfur Dioxide	1.48	0.27	42.4
Volatile Organic Compounds (VOCs)			
Total VOCs	0.93	3.69	28.7
Hazardous Air Pollutants (HAPs)			
Total HAPs	1.79 E –3	1.56	15.5
Any individual HAP	<1	<1	5.4

Source: NASA LaRC 1999 and 2000 Emission Statements and State Air Operating Permit
*From Air Permit 1/3/01.

2.2.2.1 Air Pollution Sources

The air emissions sources described below are permitted under the Center's current Air Operating Permit. The locations of these air emissions sources are listed in Table 2-4.

West Area Steam Plant (Building 1215) - The West Area Steam Plant has four boilers: a 66-MBtu natural gas-fired boiler, a 120-MBtu dual-fired natural gas and #2 fuel oil boiler, and two 168-MBtu dual-fired natural gas and #2 fuel oil boilers. Natural gas is the primary fuel for all four boilers. In the event there is an interruption of natural gas service, three of the boilers are capable of burning #2 fuel oil. The boilers are equipped with flue gas recirculation and low NOx burners to reduce emissions. The West Area Steam Plant provides steam for NASA LaRC research facilities. Institutional steam is provided by the Refuse-Fired Steam Generating Facility (RFSGF) in Building 1288. The RFSGF is operated by the City of Hampton under a separate air permit issued by VDEQ. Approximately 78 percent of the total NASA LaRC West Area steam demand is supplied by the RFSGF and 22 percent by the West Area Steam Plant.

East Area Steam Plant (Building 647) - The East Area Steam Plant has two 14.645 MBtu natural gas and #2 fuel oil fired boilers. Natural gas is the primary fuel for the boilers. In the event there is an interruption of natural gas service, or if economics dictate, the boilers are capable of burning #2 fuel oil. These boilers provide steam for the research tunnel in Building 647 and provide some steam for space heating.

Space Heaters - The Center operates both #2 fuel oil-fired and natural gas-fired space heaters. The space heaters range in size up to 3.34 MBtu/hr.

Sudden Expansion Burners (Building 1221A) - The Jet Noise Laboratory operates two Kaiser Marquardt 3" x 8" Sudden Expansion Burners. These propane-fired burners are used in the tunnel for research activities and are a source of criteria pollutant emissions.

National Transonic Facility Burners (Building 1236) - Four natural gas fired burners at this facility are used to heat the cold exhaust from the cryogenic tunnel to prevent the formation of ground fog.

Emergency Generators and Fire Pumps - The Center operates twelve diesel fueled emergency generators at various locations that are used for providing power during interruption of electrical service and for periodic testing. The eight diesel fueled fire pump engines are used to power the pumps for the aircraft hangar water deluge fire suppression system.

Arc-Heated Scramjet Test Facility (Building 1247B) - Uses an electric arc heater to heat air in the research test chamber. Exhaust gas is a source of NOx emissions.

Direct-Connect Supersonic Combustion Test Facility (Building 1221D) – Uses a hydrogen and air combustion heater with oxygen replenishment. The exhaust gas from this facility is a source of NOx emissions.

Combustion Heated Scramjet Test Facility (Building 1221D) – Uses a hydrogen, air, and oxygen heater. Exhaust from this facility is a source of NOx emissions.

8-Foot High Temperature Tunnel (Building 1265) - Combustion-heated wind tunnel and combustion exhaust from the tunnel test medium is a source of criteria pollutants.

Degreaser/Parts Washers - Solvent degreasers/parts washers are located in several facilities and are a source of VOCs and HAPs emissions.

Spray Booths - Paint and plasma arc spray booths are located in several facilities and are a source of Particulate Matter, VOCs, and HAPs emissions.

Dust Collectors – Dust collectors (including fabric filter and cyclone collectors) are located at several facilities and are a source of Particulate Matter emissions.

Investment Casting Wax Burn-out Furnace (Building 1237A) - Source of combustion emissions from the natural gas fired furnace burners and particulate emissions from the burning of wax and resin out of molds inside the furnace. The furnace is equipped with a secondary burner to reduce particulate emissions.

Underground Gasoline Storage Tanks - Two 8,000 gallon underground gasoline storage tanks at the vehicle refueling area are a source of VOCs and HAPs emissions.

Table 2-4
LOCATIONS OF PERMITTED AIR EMISSION SOURCES

Air Emission Source	Building Location(s)
Kaiser Marquardt Sudden Expansion Burners	1221A
Cleaver Brooks Boilers	647
Space Heaters #2 fuel oil-fired	1228, 1258, 1260, 1271, 1297, 1297C, 1300
Space Heaters natural gas-fired	644, 1187-1191, 1197, 1198, 1245,
Babcock & Wilcox Boilers and English Boiler	1215
Burners at the National Transonic Facility	1236
Emergency Generators and Fire Pumps	641, 1201, 1202, 1211, 1213, 1215, 1236A, 1244A, 1248, 1250, 1268, 1297, 1268C, 1300
Arc-Heated Scramjet Test Facility	1247B
8-Foot High Temperature Tunnel	1265
Degreaser/Parts Washing Units	648, 1146, 1188, 1189, 1199, 1225, 1233, 1244, 1250, 1251, 1261, 1283, 1238A, 1247E, 1293A, 1297C
Paint Booths	1148, 1230, 1283, 1296, 1232A, 1238B, 1244D, 1268D, 1298
Investment Casting Wax Burn-Out Furnace	1237A
Underground Storage Tanks	1199
Direct-Connect Supersonic Combustion Test Facility	1221D
Combustion Heated Scramjet Test Facility	1221D
Dust Collectors	1225, 1237A, 1238A, 1238B, 1245, 1283, 1292

2.2.2.2 Emission Source Conditions

The air permit is designed to limit the amount of air pollution that LaRC may emit. Specific permit requirements vary according to the air pollution source, but they generally include physical, operational, record keeping and reporting requirements. Physical requirements include control equipment to limit emissions such as low NOx burners on boilers and filters on paint booths and monitoring equipment such as meters and thermometers to measure emissions or process rates. Operational requirements include limits on the amount and type of fuel burned or materials processed, the frequency and duration of operations, and the types and amounts of product that can be used, such as paints and solvents.

Monthly record keeping requirements include documentation that physical and operational requirements are met, records of the quantity of products, fuels and materials used, records on the frequency and duration of operations, and monthly emissions from each source.

Reporting requirements include Quarterly Fuel Reports and an annual inventory and emissions statement. The permit also requires that VDEQ be notified immediately of any accidental releases, breakdowns, or changes in operations that result in air pollution emissions.

2.2.3 Ozone Depleting Compounds

NASA LaRC tracks the use of ozone-depleting compounds and actively seeks alternatives for eliminating or reducing the use of ODCs. Currently, CFCs are used for building and automotive air conditioners and for high-precision cleaning operations. The Center has substituted the Class II ODCs for Class I ODCs, instituted recycling and reclamation of Class I ODCs still in use, and converted some processes from using ODCs altogether. Consumption data are submitted to NASA Headquarters via the NASA Environmental Tracking System (NETS) annually.

Table 2-5 shows CFC usage at NASA LaRC from 1993 to 2000.

Table 2-6
NASA LaRC CHLOROFLUOROCARBONS (CFC) USE COMPARISON FOR CLASS I SUBSTANCES

Material / Use	Quantity (lbs.)						
	1994	1995	1996	1997	1998	1999	2000
CFC 11 Refrigerant	1,800	2,600	0	0	0	0	0
CFC 12 Refrigerant	5,695	4,110	1,795	240	269	123	0
CFC 113 Refrigerant	1,600	721	0	0	0	0	0
CFC 113 Cleaner/Solvent	5,043	25	25	332	2,644	309	8
TOTAL	14,138	7,456	1,820	572	2,913	432	8

Source: NASA LaRC EMO Records, 1993-2000

2.2.4 Climate

The climate in the Langley area is a modified continental type with generally mild winters and warm, humid summers. Mountains to the west and the Chesapeake Bay and Atlantic Ocean to the east are the major factors affecting Langley's climate. The mountains produce various modifying effects on passing storms and air masses, while the nearby open bodies of water, slow to react to atmospheric changes, contribute greatly to the humid summers and mild winters.

Daytime high temperatures during the winter are usually near 50°F (10°C) with nighttime lows of 30°F (near 0°C). A maximum temperature of 81°F (27°C) and a minimum of -3°F (-20°C) are the extremes recorded during the winter season. The maximum temperature is below freezing on an average of 5 days each year, while the minimum temperature falls below freezing 13 to 17 days a month during the winter months.

Daytime highs during the summer are usually in the middle 80s°F (upper 20s°C) with nighttime lows generally around 70°F (20°C). Maximum temperatures up to 105 °F (40°C) and minimum temperatures as low as 43°F (6°C) are the extremes recorded during this period. The average date of the last freezing temperature in spring is March 25, and the average date of the first freeze in fall is November 17. Freezing temperatures have occurred as late as April 21 and as early as October 27.

Precipitation is well distributed throughout the year with the minimum in July and August and the maximum in November and April. Monthly totals have ranged from less than one-quarter of an inch to over 15 inches (in) (0.01 meter [m] to over 0.38 m). The highest daily total - over 6 in (.15m) occurred during September 1972. Nearly 40 days each year have thunderstorm activity, which is close to the average for the state. In winter, some of the precipitation occurs as snow. The average is about 9 in (.23m) a year, but total snowfall is extremely variable, ranging from none to nearly 45 in (1.14m).

South to southwest winds predominate, but a secondary maximum from a northerly direction reflects the progression of weather systems across the state. Cloudiness is least during the fall season, averaging about five-tenths coverage, and greatest in winter, with six-tenths coverage.

Hurricanes and other tropical disturbances seldom move close enough to affect Langley. In most cases, when they arrive in this area, they have decreased in strength to less than hurricane intensity, but they may still cause considerable damage from high winds and heavy rains. Category II and III hurricanes have been recorded a few times in the last 60 years. Category IV hurricanes have been recorded in the area twice in the last 400 years. Tornadoes are quite rare. Thunderstorms, accompanied by lightning and high winds, are much more frequent and produce the greatest amount of storm damage in the area.

2.3 MAJOR ENVIRONMENTAL CONSIDERATIONS FOR PROPOSED ACTIONS

Air pollution regulations and the Center's air permit must be considered before facilities or operations at NASA LaRC add, install, move, change, or reactivate an air pollution source. Refer to Table 2-4 for current NASA LaRC permitted air sources. All new projects must be evaluated to determine if the facility or its operations will include any sources of air emissions. The Center must notify VDEQ prior to installing, moving or reactivating an air pollution source.

Facilities must notify the EMO immediately of any accidental releases, breakdowns, or changes in operations that may affect air pollution emissions and of any plans to add, change, remove, or relocate an air pollution source. Facilities must also make sure accurate records are maintained and are readily available for compliance review.

Any project or facility operation that may use Class I or Class II ODS, HAPs or VOCs, or products containing these, should determine if suitable replacements for these compounds exist and if so, used instead.

In any case, the evaluation of the air quality impacts of a new project must be coordinated through the EMO.

3.0 WATER RESOURCES

3.1 REGULATORY OVERVIEW

3.1.1 Safe Drinking Water Act

The Safe Drinking Water Act (SDWA), originally passed by Congress in 1974, protects public health by regulating the nation's public drinking water supply. The law was amended in 1986 and 1996 and it authorizes the EPA to set national health-based standards for drinking water and its sources – rivers, lakes, reservoirs, springs, and ground water wells. The EPA has implemented regulations to enforce the SDWA in 40 CFR Parts 141 through 149.

The most direct oversight of water systems is conducted by state drinking water programs. States can apply to the EPA for the authority to implement SDWA within their jurisdiction if their standards are at least as stringent as the EPA's. The Virginia State Department of Health has primary responsibility for administration and enforcement of primary drinking water regulations and related requirements applicable to public water systems in Virginia. "The Waterworks Regulations" can be found in Title 32.1 of the Code of Virginia.

3.1.2 Clean Water Act

The Clean Water Act (CWA) is a 1977 amendment to the Federal Water Pollution Control Act of 1972. The CWA gave the EPA the authority to set discharge standards on a technology-based or industry basis in addition to setting water quality standards for all contaminants in surface waters. The CWA makes it unlawful for any person to discharge any pollutant from a point source into navigable waters unless a permit is obtained. The CWA's primary mechanism for imposing limitations on pollutant discharges is a national permit program established under Section 407 and referred to as the National Pollutant Discharge Elimination System (NPDES). Under this program, the State of Virginia has implemented the Virginia Pollutant Discharge Elimination System (VPDES) program that is at least as stringent as the federal limits.

The CWA, as amended by the Oil Pollution Act of 1990, also regulates discharges of oil to waters of the U.S. Facilities which, due to their location, could reasonably be expected to discharge harmful quantities of oil to U.S. waters, are required to prepare a Spill Prevention Control and Countermeasure (SPCC) Plan and/or Facility Response Plan.

The Commonwealth of Virginia Water Control Law forms the basis for protecting water quality, prevention and control of pollution, and reducing existing pollution of state waters. The Virginia Department of Environmental Quality (VDEQ) Water Division sets stream quality and utilization standards for all state waters.

3.1.3 Wild and Scenic Rivers

The Wild and Scenic Rivers Act (16 U.S.C. 1271, et seq.) establishes requirements for water resource projects affecting wild, scenic, or recreational rivers within the National Wild and Scenic Rivers System. The protective restrictions under the Act mostly apply to federal agencies; however, private projects that require federal agency approval or permits may also be affected.

3.2 NASA LANGLEY OPERATIONS

3.2.1 Surface Waters

NASA LaRC is located on the small coastal basin of the Back River, a tidal estuary of the Chesapeake Bay. The Brick Kiln Creek runs along the western boundary of NASA LaRC, joining the northwest branch of the Back River, and drains approximately 40 percent of the West Area at the Center. Tabbs Creek, which drains most of the rest of the West Area and part of LAFB, flows in a northerly direction to join the Back River near the confluence of its northwest and southwest branches. A small portion of the West Area in the south drains to Tides Mill Creek. The East Area drains to the Back River. The local waterways are influenced by tides in the Chesapeake Bay. The waters in the local streams are designated by the State as Class IIa, estuarine waters where shellfish can be found.

Stream quality standards, applicable to the Back River and its tributaries, which are an important source of shellfish, crabs, and fish, are shown in Table 3-1.

Table 3-1
WATER QUALITY STANDARDS APPLICABLE TO THE BACK RIVER AND ITS TRIBUTARIES

Basin and Section	Chesapeake Bay and Atlantic Ocean.
Location	Chesapeake Bay and its tidal tributaries from Thimble Shoal Channel north to Virginia-Maryland state line, between longitude 76^{o}10'W and east-west divide boundary on the eastern shore of Virginia.
Water Use Class	II a
Water Use Designation	Generally satisfactory for use as public or municipal water supply, primary contact recreation (prolonged intimate contact, considerable risk of ingestion), propagation of fish and other aquatic life, and other beneficial uses.
Dissolved Oxygen	Minimum: 4.0 mg/l; Daily Average: 5.0 mg/l
Coliform Organisms	In all open ocean or estuarine waters capable of propagation of shellfish or in specific areas where public or leased private shellfish beds are present, and including those waters on which condemnation or restrictions are established by the State Department of Health, the following standards for fecal coliform bacteria will apply: the median fecal coliform value for a sampling station shall not exceed an MPN of 14/100 ml of sample and not more than 10% of samples shall exceed a 43 5-tube, 3-dilution test, or 49 for a 3-tube, 3-dilution test.

Table 3-1 WATER QUALITY STANDARDS APPLICABLE TO THE BACK RIVER AND ITS TRIBUTARIES	
	In waters that are not capable of shellfish propagation, fecal coliforms (multiple-tube fermentation or MF count) within a 30-day period not to exceed a log mean of 200/100 ml. Not more than 10% of samples within a 30-day period shall exceed 400/100 ml. Monthly average not more than 2400/100 ml (MPN or MN count). Not more than 2400/100 ml in more than 20% of samples in any month (sic).
pH	6.0 to 9.0
Temperature (^{o}C)	Any rise above natural temperature of 3^{o} or more will be reviewed on a case-by-case basis by the VDEQ.
Special Standards	Areas containing shellfish are not contaminated by radionuclides, pesticides, herbicides, or fecal material so that consumption of shellfish may be hazardous.
Source: Virginia Water Quality Standards 9 VAC 25-260-5 et seq., 1998	

None of the waterways within the NASA LaRC property qualify for the provisions of the Wild and Scenic Rivers Act, although some do in the Hampton Roads area.

The water supply for NASA LaRC is obtained from Newport News Water Works. The Bethel Manor Reservoir, which is operated by the U.S. Army, serves as a backup in case of emergency. The system at NASA LaRC consists only of distribution facilities; there are no water production or treatment facilities.

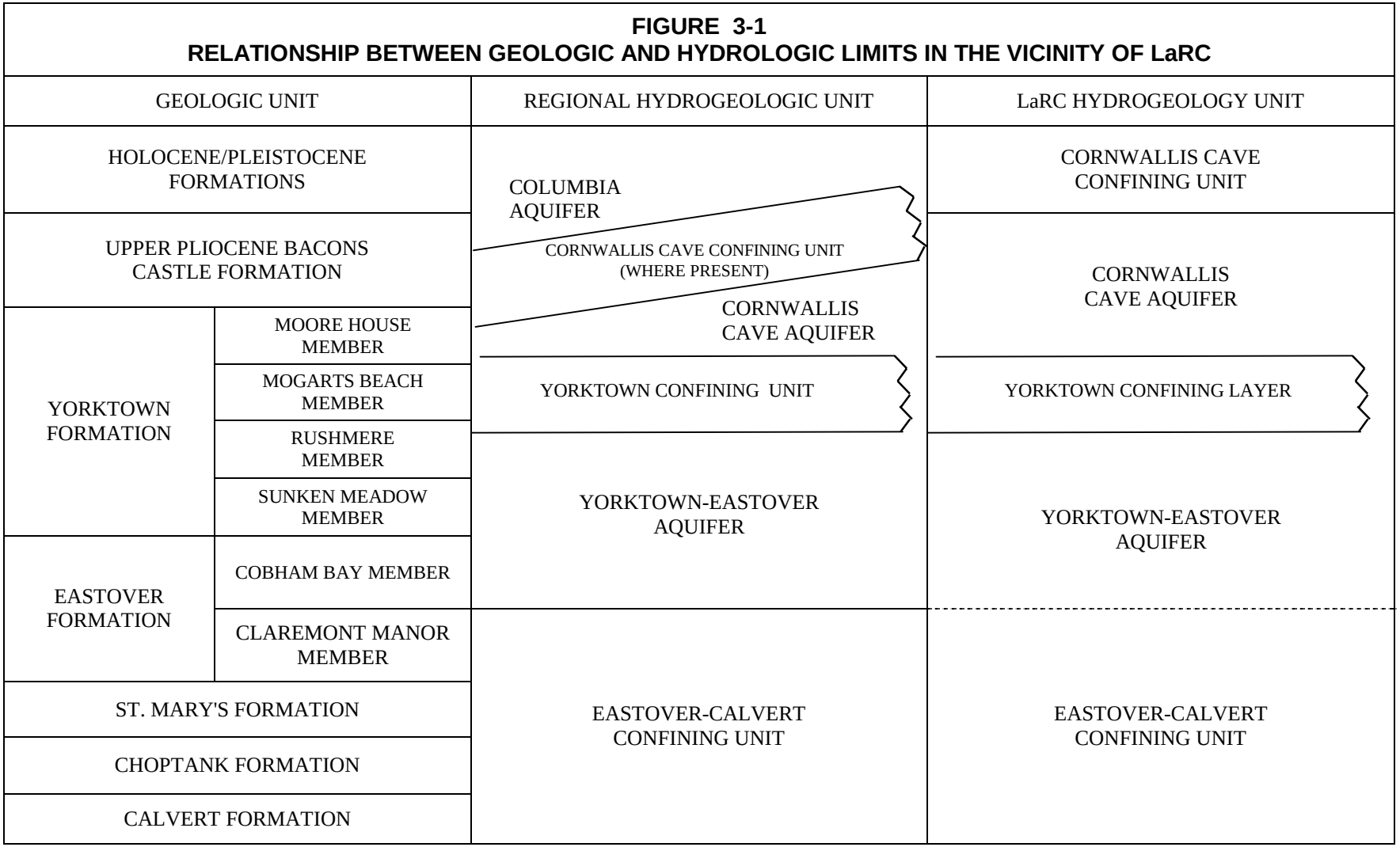
3.2.2 Groundwater

Hydrogeology

Detailed information on the regional hydrogeology is sparse. The U.S. Geological Survey Professional Paper (Meng and Harsh, 1988) provides information on the overall stratigraphy and the regional aquifer system of the Virginia Coastal Plain. This aquifer system comprises the following units: the Columbia Aquifer, followed by the Cornwallis Cave Confining Unit, the Cornwallis Cave Aquifer, the Yorktown Confining Unit, the Yorktown-Eastover Aquifer, and the underlying Eastover-Calvert Confining Unit. In several locations of York County, the aquifer system is not fully divided into these constituent units (Brockman and Richardson, 1992). The Cornwallis Cave and Yorktown Confining Units are absent in the east-central part of York County.

A detailed description of the composition of the aquifers can be found in the 1999 update of this document which is maintained by the EMO. The relationship between the underlying geological units and the hydrogeological units is presented in Figure 3-1. For a detailed discussion of regional geology, see Section 4.2.

FIGURE 3-1
RELATIONSHIP BETWEEN GEOLOGIC AND HYDROLOGIC LIMITS IN THE VICINITY OF LaRC



Source: Ebasco, 1995

Groundwater Flow

Groundwater flow in the aquifers and the confining units is generally downward. Local recharge of the water to the groundwater system is by precipitation which filters downward into the surface sediments of the Columbia Aquifer.

Groundwater movement at NASA LaRC is tidally influenced at locations near Brick Kiln Creek and Tabbs Creek. A total of 32 shallow wells (depth up to 20 feet or 6 m), 7 intermediate wells (75 feet or 22.9 m), and 5 deep wells (depths over 95 feet or 29 m) have been installed over the years to identify/monitor potential contamination of groundwater at NASA LaRC. Table 3-2 lists the sites where the groundwater monitoring wells are located.

Table 3-2
NASA LANGLEY RESEARCH CENTER
MONITORING WELLS

Site	Number of Wells
Chemical Waste Pit (Pyrotechnics Area)	3
Construction Debris Landfill	15
Stratton Road Substation	4
Area E Warehouse	5
Shallow Wells - Perimeter	5
Intermediate Wells - Perimeter	7
Deep Wells - Perimeter	5
TOTAL	44

3.2.3 Water Quality

Surface Water

The VDEQ Water Division collects water quality data on a regular basis for the Brick Kiln Creek. This data is collected near the Route 134 Bridge over the creek, located approximately one mile northwest of NASA LaRC. A summary of water quality data collected for the period 1991 to 1998 is presented in Table 3-3. The VDEQ collects water quality data on a regular basis from five other monitoring stations located in waterways around NASA LaRC and Langley Air Force Base. A summary of the five monitoring station water quality data collected from 1994 to 1997 is presented in Table 3-4.

Table 3-3
WATER QUALITY DATA FOR BRICK KILN CREEK
(all data are in mg/l unless otherwise indicated)

Parameter	# of Observations	Mean
Temperature ^{o}C	89	15.58
Dissolved Oxygen	89	6.6
5-day BOD	91	2.32
Salinity	75	4.07
pH units	89	7.42
Ammonia	91	0.08
Total Nitrogen (Nitrites)	91	0.01
Total Nitrogen (Nitrates)	91	0.08
Total Kjeldahl Nitrogen	91	1.06
Total Phosphates	90	0.12
Dissolved Phosphates (Ortho)	14	0.02
Total Organic Carbon	63	0.87
Arsenic ug/l	4	8.8
Beryllium ug/l	1	10.0
Cadmium ug/l	4	8.75
Copper ug/l	4	18.25
Iron ug/l	5	410.78
Lead ug/l	4	10.34
Manganese ug/l	5	185.66
Nickel ug/l	4	10.0
Zinc ug/l	4	20.11
Fecal Coliform (MFM)/100 ml	15	1,361.27
Fecal Coliform (MPN)/100 ml	77	808.88

Source: VDEQ, Tidewater Office. Mean of readings taken between 1/1/91 and 12/31/98.

Table 3-4
WATER QUALITY FOR BACK RIVER
(all data are in mg/l unless otherwise indicated)

Sampling Location* / Parameter	1	2	3	4	5
Dissolved Oxygen	8.8	8.04	8.4	8.3	8.2
Temperature ^{o}C	16.43	17.03	16.9	16.8	16.9
pH	7.89	7.7	7.8	7.8	7.7
Total Organic Carbon (TOC)	5.45	7.63	8.57	4.35	7.4
Total Coliform (MPN) (mean/100 ml)	63.6	183.1	145.4	234.7	215.3
Total Kjeldahl Nitrogen	0.55	0.72	0.57	0.55	0.67
Ammonia	0.07	0.06	0.06	0.06	0.07
Nitrite	0.01	0.01	0.01	0.01	0.01
Nitrate	0.04	0.04	0.04	0.04	0.04
Total Phosphate	0.17	0.14	0.1	0.12	0.2

*These sampling stations are shown on Figure 3-2.

Source: VDEQ, Tidewater Office; means for samples collected from 1/1/94 through 12/31/97.

Tabbs Creek, a tributary of the Back River, drains entirely within NASA LaRC and LAFB property. Sampling studies conducted in the 1980's showed polychlorinated biphenyl (PCB) and polychlorinated terphenyl (PCT) contamination in the creek sediment and in the storm sewer lines connected to Outfall 009 (Figure 3-3). The contaminated portion of the storm sewer system was cleaned in 1995 under a Federal Facilities Compliance Agreement signed by NASA LaRC in 1990 with EPA and Virginia State agencies. In the Spring of 2000, LaRC completed clean-up of the PCB/PCT contaminated sediments in Tabbs Creek.

In 1992, NASA LaRC conducted sampling of Tabbs Creek as part of a remedial investigation. The study analyzed water samples from Tabbs Creek and compared the sample results to EPA's Ambient Water Quality Criteria (AWQC) and the Commonwealth of Virginia surface water standards for human-health-based criteria and ecology-based criteria. Human health and ecological risk assessments concluded that the contaminants found in surface water did not pose significant risks to human health or the environment. The LaRC Environmental Management Office maintains the sample results and documentation of the study.

Groundwater Quality

Groundwater at NASA LaRC is often brackish because of the Chesapeake Bay's close proximity and marine deposits found in the soil. Despite these conditions, there are a few individual water wells in the area. General groundwater chemical characteristics are presented in Table 3-5.

Since 1995, samples collected from the monitoring wells at LaRC have not shown contamination of the groundwater. Currently, groundwater level measurements are obtained from the monitoring wells on a quarterly basis and analysis of the groundwater is conducted annually. Monitoring results are maintained by the EMO.

Table 3-5
NASA LARC HYDROGEOLOGICAL STUDY
INORGANIC COMPOUND MAXIMUM CONCENTRATIONS

Compound	Maximum Concentration Detected (ug/l)		Virginia MCL (*ug*/l)
	Unfiltered Samples	Filtered Samples	
Aluminum	38,900	603	
Antimony	130	ND	
Arsenic	37.6	ND	50
Barium	384	421	2,000
Beryllium	3.3	ND	
Cadmium	2.0	0.6	16
Calcium	338,000	373,000	
Chromium	119	ND	170
Cobalt	65.3	26.1	
Copper	41.4	ND	1,300
Iron	124,000	854	300
Lead	53.0	32.2	15
Magnesium	105,000	104,000	
Manganese	2,230	1,530	
Mercury	0.10	ND	0.144
Nickel	171	ND	607
Potassium	164,000	261,000	
Selenium	3.9	ND	172
Silver	12.6	17.0	
Sodium	498,000	554,000	
Vanadium	86.3	ND	
Zinc	222	105	5,000
Cyanide	ND	NA	700

Source: 1995, Hydrogeological Investigation Report, LaRC, Ebasco Services Incorporated.

3.2.4 Water Permits

NASA LaRC does not draw water from the surface water resources, nor does it have any collection or treatment facilities. Since the Center obtains all of its water from independent sources and the public water system, and it does not sell the water or operate as an interstate commerce carrier, LaRC is exempt from the SDWA and Virginia Waterworks Regulations.

NASA LaRC operates under two water discharge permits, one from the VDEQ and the other from the Hampton Roads Sanitation District (HRSD). HRSD Permit No. 0085 allows NASA LaRC to discharge non-hazardous industrial wastewater and sanitary sewage to the HRSD sanitary sewer system.

VPDES Permit No. 0024741 authorizes NASA LaRC to discharge in accordance with the effluent limitations and monitoring requirements set forth in the Permit. LaRC is allowed to discharge effluent from its operations to the surface waters of Virginia at 10 locations, called outfalls. Three other outfall locations contain only stormwater runoff rather than process water, and no monitoring is required. The location of the 13 outfalls

is shown in Figure 3-3. Table 3-6 provides a summary of the 13 NASA LaRC outfall locations.

NASA LaRC does not operate any oil transfer operations over water and does not store more than 1,000,000 gallons of oil onsite. Therefore, NASA LaRC is not required to submit a Facility Response Plan to the EPA or the Coast Guard as laid out in the Oil Pollution Act of 1990. The Center has an Integrated Spill Contingency Plan that complies with the Spill Prevention Control and Countermeasure (SPCC) requirements of the EPA's Oil Pollution Prevention Regulations. Copies of this plan are maintained by the EMO.

Table 3-6
NASA LARC STORMWATER OUTFALL SUMMARY

Outfall	Source	Receiving Water Body
001	Cooling Tower Blowdown and Stormwater Runoff	Tides Mill Creek and the Chesapeake Bay
002	Cooling Tower Blowdown and Stormwater Runoff	Tabbs Creek and the Chesapeake Bay
003	Cooling Tower Blowdown, Stormwater Runoff (oil/water separator), Bearing Cooler and Electron Scope Cooling Water, and Water Softener Discharge	Tabbs Creek and the Chesapeake Bay
004	Cooling Tower Blowdown and Stormwater Runoff	Southwest Branch of Back River and the Chesapeake Bay
005	Cooling Tower Blowdown, Landing Loads Test Facility Discharge, and Stormwater Runoff	Brick Kiln Creek and the Chesapeake Bay
006	Landing Loads Test Facility Discharge and Stormwater Runoff	Brick Kiln Creek and the Chesapeake Bay
007	Stormwater Runoff	Brick Kiln Creek and the Chesapeake Bay
008	Cooling Tower Blowdown, Stormwater Runoff, and Car Wash	Tabbs Creek and the Chesapeake Bay
009	Cooling Tower Blowdown, Stormwater Runoff (oil/water separator), and A/C Condensate	Tabbs Creek and the Chesapeake Bay
010	Cooling Tower Blowdown and Stormwater Runoff (oil/water separator)	Southwest Branch of Back River and the Chesapeake Bay
011	Stormwater Runoff	Northwest Branch of Back River
012	Stormwater Runoff	Tabbs Creek and the Chesapeake Bay
013	Stormwater Runoff and Tow-Tank Test Facility Discharge	Southwest Branch of Back River and the Chesapeake Bay

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Figure3-3: West Area Outfall Locations
Legend: NASA Facilities, Outfall Location (VPDES Permit)

Figure3-4: East Area Outfall Locations
Legend: NASA Facilities, Outfall Location (VPDES Permit)

3.2.5 Sources Of Water Pollution

Water pollution sources at LaRC are limited due to the relatively low level of industrial operations at the Center. The major pollutants are the chemicals used to treat the boilers and cooling towers. Discharge of these pollutants is in accordance with the Center's VPDES permit. Wastewater from the photographic laboratory at Building 1155 is pretreated to remove silver and discharged in accordance with HRSD permit requirements. The disposal or discharge of laboratory chemicals into sinks or drains is a potential pollutant source, however LaRC policy prohibits this practice. The Center employs various Best Management Practices (BMP's) to prevent or mitigate stormwater and/or sewer system pollution from facility activities. These include employee training, preventive maintenance, visual inspections, spill prevention and response, sediment and erosion control, good housekeeping, and record keeping and reporting. BMP's are also employed in the Center's pesticide and herbicide program. There are no traces of pesticides or herbicide runoff leaching from landscaping activities.

Land-clearing and construction activities are carried out in compliance with appropriate State requirements and, historically, have not caused any increased sediment discharge into receiving waters.

3.3 MAJOR ENVIRONMENTAL CONSIDERATIONS FOR PROPOSED ACTION

Proposed actions should identify any increased stormwater or sewer discharge requirements and the potential for exceeding contaminant concentrations set by the Center’s permits.

The Center's water permits and the water pollution regulations must be considered before facilities or operations at NASA LaRC add or modify a process that discharges wastewater. All new projects must be evaluated to determine if the facility or its operations will include any wastewater discharges.

Facilities must notify the EMO immediately of any accidental releases of oil or other pollutants that may contaminate the Center’s sanitary or storm sewer system.

The evaluation of the water quality impacts of a new project must be coordinated through the EMO.

3.4 REFERENCES

Meng and Harsh, 1988 - Hydrogeologic Framework of the Virginia Coastal Plain: Regional Aquifer-System Analysis. U.S. Geologic Survey Professional Paper 1404-C. Washington, D.C.

Brockman and Richardson, 1992 - Hydrogeologic Framework of the Shallow Aquifer System of York County, VA, USGS Report No. 92-411.

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4.0 LAND RESOURCES

4.1 REGULATORY OVERVIEW

4.1.1 Clean Water Act

Section 404 of the Clean Water Act requires a permit from the U.S. Army Corps of Engineers (ACOE) for all activities involving dredging or filling of waters of the United States, including wetlands. The EPA is the permitting authority and the U.S. Fish and Wildlife Service (USFWS) is a reviewing agency. The regulations implementing the Section 404 permit program are contained in 33 CFR 320(1)(2)(r) and 40 CFR 230. Under the Section 404 permit program, a dredge/fill project may require an individual action specific permit, or it may be covered by a nationwide or a regional permit. Within Virginia projects involving the use or development of tidal wetlands require a permit from the Virginia Marine Resources Commissions (VMRC).

4.1.2 Wetlands

Wetlands are transitional areas between upland and aquatic systems; as such, they have characteristics of, and integrate with, both types of systems. Wetlands are recognized to have important ecological functions. Generally, they provide habitat for a variety of species; marsh wetlands provide important spawning and nursery habitat for a number of aquatic species. Wetlands also play important roles in moderating flood flow, filtering sediments and nutrients out of surface waters, and providing groundwater recharge.

As the primary agency with authority under Section 404 of the CWA for wetland delineation, the ACOE developed a manual in 1987 for delineating regulated wetlands. In accordance with the 1987 Manual, an area is considered to be a wetland if under normal circumstances it meets the following criteria: (1) hydrophytic vegetation, (2) hydric soils, and (3) wetland hydrology. The 1987 Manual defines these criteria and describes the conditions that indicate that the three wetland criteria are present.

4.1.3 Executive Order 11990 - Protection of Wetlands

Executive Order 11990 requires each Federal agency to “take action to minimize the destruction, loss, or degradation of wetlands, unless there is no practicable alternative, and then the proposed action must include all practicable measures to minimize harm to wetlands.” Federal agencies must provide an opportunity for early public review of any plans or proposals for new construction in wetlands.

4.1.4 Executive Order 11988 - Floodplain Management

Executive Order 11988 requires each Federal agency to "take action to reduce the risk of flood loss; to minimize the impact of floods on human safety, health, and welfare; and to restore and preserve the natural beneficial values served by floodplains in carrying out its responsibilities." Federal agencies must determine whether a proposed action will occur in a floodplain, and must consider alternatives. If there are no practicable

alternatives to locating a project within the floodplain, the project proponent must include floodplain protection provisions, and must circulate for a public review a notice of why the action is proposed to be located within the floodplain. A floodplain assessment must be included in any EA or EIS for the project.

4.1.5 NASA Requirements on Floodplains and Wetlands

NASA regulations on floodplain and wetlands management are specified in 14 CFR 1216.2. Regulations require NASA field installations to include floodplain and wetland protection in their master planning activities. The NASA regulations and management instructions require consultation with the ACOE, USFWS, and Federal Emergency Management Administration (FEMA), and public notice for project development in wetlands or floodplains.

4.1.6 Coastal Zone Management Act

The Federal Coastal Zone Management Act of 1972 (16 USC § 1451 et seq.) requires that federal actions that will have reasonably foreseeable effects on the land or water uses or natural resources of a State's coastal zone must be consistent with federally approved State Coastal Management Programs. These "coastal effects" include direct effects, as well as cumulative and secondary effects resulting from the Federal action(s).

The Commonwealth of Virginia has an approved Coastal Resources Management Program (VCRMP), which is administered by the Virginia Department of Environmental Quality (VDEQ), Division of Public and Intergovernmental Affairs. Virginia's Coastal Program is reauthorized every four years by Executive Order signed by the Governor. The Program's most recent goals and objectives are in Executive Order Number Twenty-Three (98) available at: http://www.deq.state.va.us/coastal/exorder.html.

The Virginia Coastal Program includes the following core programs: Coastal Land Management, Dunes Management, Fisheries Management, Nonpoint Source Water Pollution Control, Point Source Water Pollution Control, Shoreline Management, Subaqueous Lands Management and Wetlands Management. A description of these programs and the administering agencies can be found at: http://www.deq.state.va.us/coastal/core.html

4.1.7 Virginia Wetlands Act

The Virginia Wetlands Act (Chapter 13 of the Laws of Virginia Relating to Submerged Lands, Wetlands, and Coastal Primary Sand Dunes and Beaches, Title 28.2-1300 through 28.2-1320) requires a permit from VMRC for any activity which would use or develop a tidal wetland. The VMRC has issued wetland guidelines that specify the criteria for evaluating the permit application. The VMRC also has issued a Wetlands Mitigation-Compensation Policy (4VAC20-390). The Virginia Wetlands Act allows VMRC to delegate all or part of its permit responsibilities to an approved local wetland board. The Cities of Hampton and Poquoson each have an approved local wetland board.

4.1.8 Virginia Chesapeake Bay Preservation Act

The Chesapeake Bay Preservation Act (Title 10.1-2100 through 10.1-2115) was enacted in 1988 to establish a cooperative state-local program to preserve the water quality of the Chesapeake Bay. The Act requires the counties, cities, and towns, of Tidewater Virginia to incorporate general water quality protection measures into their comprehensive plans, zoning ordinances, and subdivision ordinances, and to establish programs to define and protect certain areas [i.e., Resource Protection Areas (RPA)]. The Act is administered at the state level by the Chesapeake Bay Local Assistance Board. The City of Hampton is a Tidewater City under the Chesapeake Bay Preservation Act, and has an approved Chesapeake Bay Preservation Act program.

4.2 NASA LANGLEY OPERATIONS

4.2.1 Geology and Topography

NASA LaRC is located in the Atlantic Coastal Plain physiographic province of Virginia. Regionally, this province consists of an eastward-thickening sedimentary wedge composed of unconsolidated gravels, sands, silts, and clays, with variable amounts of marine fossils (Meng and Harsh, 1988). NASA LaRC is located in the lower York-James Peninsula of York County, and the Hampton flat is the principal geomorphic feature in the county. The surface of the Hampton flat has a gentle eastward dip at about 1.0 ft per mile (0.6 m per 1.6 km) (Johnson, et al., 1987). Drainage is poor throughout the area and saltwater and freshwater marshes are common along the major streams flowing into the Chesapeake Bay.

LaRC is underlain by approximately 2,000 ft (660 m) of unconsolidated sediments, and igneous and metamorphic basement rock (Cederstrom, 1945). The uppermost soil units (excluding fill material) are Holocene age deposits, and Pleistocene deposits of the Norfolk Formation. Holocene deposits, consisting of organic clays, silts, and silty clays are encountered in proximity to the margins of the tidal estuaries which border NASA LaRC. These deposits are up to 30 feet (10 m) in thickness along the northern border of the facility.

NASA LaRC sits on the rim of a 35-million year old crater that was identified in 1993, but wasn't confirmed until 1999 (Britt, 2001). In the summer of 2000, the U.S. Geological Survey drilled a 2,000-foot deep hole to obtain core and rock sediment samples from beneath the Center. These samples will be beneficial to an ongoing research project of the impacts of the crater on the Chesapeake Bay and southeastern Virginia's groundwater resources.

4.2.2 Seismicity

Although Virginia is a state with considerable seismic activity, earthquakes are low intensity (VI or less on the Modified Mercali Scale), and are concentrated in the central and western portions of the state in the Piedmont and the Valley and Ridge physiographic provinces. LaRC is located in an area designated as Seismic Risk Zone

1, which is an area with minor damage expected (Coffman and Von hake, 1973). Only one earthquake with its epicenter near the study areas has been reported; however, many small shocks with epicenters outside of the area have been felt in the NASA LaRC area.

4.2.3 Soils

The soils at LaRC range in texture from clay and silt to fine gravel, with most of the soils being fine to medium sandy loam. The surface is a deposited loam from two to six feet in depth.

There is no comprehensive Soil Conservation Service (SCS) Soil Survey covering the NASA LaRC area. Consequently, the Center-wide wetlands field survey performed by Old Dominion University (ODU, 1991a,b,c, 1992) used the SCS Soil Survey of James City and York Counties and the City of Williamsburg, Virginia (USDA, 1985) as a guide for determining the soil types present in the area. The wetland field survey then classified the NASA LaRC soils into these types (Day et al., 1991).

The principal soil series encountered in the wetland field survey were of the Tomotley-Altavista-Dragston map unit that includes soils of the Augusta and Seabrook series. Tomotley soils form in loamy fluvial sediments and consist of fine sandy loam and clay loam soils which occur on nearly level, broad, low-lying flats. Surface water ponding occurs in some areas. These soils are classified as hydric, having a moderately slow permeability (0.6 to 2.0 in/hr (1.5 to 5.0 cm/hr) at a depth of 2 to 3 in (5 to 8 cm)) and an apparent water table occurring within 0 to 1.0 ft (0 to .3 m) of the surface during part of the growing season.

Altavista soils form in fluvial sediments and consist of fine sandy loam. These soils occur in higher topographic areas within the Tomotley series. Altavista soils have a moderate permeability and an apparent water table of 1.5 to 2.5 ft (.5 to .8 m) below the surface; consequently, they are not classified as hydric.

Seabrook soils are fine sands occurring on low terraces along drainageways, specifically along the banks of Brick Kiln Creek. These soils have a rapid permeability and an apparent water table of 2 to 4 ft (.6 to 1.2 m) below the surface. The wetland field survey did not identify hydric soil indicators in the Seabrook soils at NASA LaRC.

Dragston soils are deep and somewhat poorly drained. These soils form in loamy fluvial sediments, and are found on low-lying stream terraces on the coastal plain. Minor amounts of Dragston soils were encountered in depressions within the Seabrook soils.

4.2.4 Land Use

LaRC lies within the City of Hampton, Virginia and it falls within the Hampton Roads Metropolitan Statistical Area which consists of the Virginia Cities of Chesapeake, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg; the Virginia Counties of Gloucester, Isle of Wight, James City, Mathews,

and York; and Currituck County in North Carolina. The Hampton Roads MSA has experienced rapid growth and development during recent decades (see Section 13).

The Langley Air Force Base (LAFB) dominates land use in the immediate vicinity of LaRC. To the east of LaRC are the northwest and southwest branches of the Back River, beyond which is the Chesapeake Bay. To the south and north of LaRC are the densely developed residential communities of Hampton and Poquoson. The area to the west of LaRC is one of the least developed areas of the City of Hampton; development immediately outside the western-southwestern LaRC boundary consists of two residential trailer parks, an apartment complex, and an auto racetrack; however, the City anticipates major development in this area.

Approximately 70 percent of the work at NASA LaRC is aeronautical research, using wind tunnels, computer modeling, and other facilities. The remainder of the work at NASA LaRC supports the national space program. LaRC has 18 major research facilities and approximately 180 shops, administrative facilities, and support facilities.

4.2.4.1 Land-Use Planning Zones

NASA LaRC has a current Facilities Master Plan which supports the Center's strategic approach to programmatic facility planning and prioritization. The Facilities Master Plan identifies ten functional zones in the West Area of NASA LaRC (Figure 4-1). Complete descriptions of the functional zones and the Facilities Master Plan can be found at website: http://gis-www.larc.nasa.gov/masterplan.new/

Most of the West Area at LaRC is developed, although several large contiguous tracts of undeveloped land exist within the Area. The largest undeveloped sections of the West Area consist of a wooded tract in the southern portion adjacent to LAFB, an extensive wooded area along State Route 172, and individual open tracts scattered throughout the northern portion of the Area. NASA LaRC uses a comparative elimination process to identify and delineate available land areas within the West Area for future development taking into account natural and man-made constraints including:

- wetlands
- floodplains
- blast safety areas
- steam-generating plant areas
- LAFB flight constraint areas
- electrical service constraints, and
- existing high-density development

These areas are shown in Figure 4-2.

The East Area is almost fully developed considering the limited space available to LaRC. The area accommodates some of the larger LaRC wind tunnel structures. It is unlikely that the Center would develop any part of the East Area.

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Insert figure 4-1

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4.2.4.2 Land Use Planning

Planning for LaRC is undertaken in stages: The conceptual study stage, the detailed planning/definition stage, and the design/construct stage. LAPG 8800.1 contains the procedures to be followed in new project planning at NASA LaRC. These procedures were established in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969 (Public Law 91-190, 42 U.S.C. 4321) and the NASA regulations implementing the provisions of NEPA (14 CFR 1216.3).

4.2.5 Wetlands

NASA LaRC is located in an area of low topographic relief surrounded by a shallow estuarine environment. The Center is close to the northwest and southwest branches of the Back River, and is within the tidal zone of the Chesapeake Bay. The principal drainage ways in the vicinity of the Center, Brick Kiln Creek and Tabbs Creek are tidal creeks with extensive tidal marshes.

In 1991 Old Dominion University performed a wetland field survey at NASA LaRC to identify and map the boundaries of forested wetlands. The predominant wetland areas in the vicinity of NASA LaRC are the tidal marsh wetlands associated with Brick Kiln Creek and Tabbs Creek (Figure 4-3). These wetland areas consist of an estuarine emergent marsh dominated by nearly uniform stands of saltmarsh cordgrass (*Spartina alternaflora*) in the lower intertidal zone, and saltmarsh hay (*S. patens*) and salt grass (*Distichlis spicata*) in the high intertidal zone. Additional dominants in the high marsh include groundsel tree (*Baccharus halmifolia*), rush (*Juncus spp*.), big cordgrass (*S. cynosuroides*) and marsh elder (*Iva fructens*). Common reed (*Phragmites australis*) is common around the upper fringes of the marshes and in areas that have been disturbed by fill, riprap, etc.

The majority of these marsh areas are relatively undisturbed and provide exceptional habitat for a variety of wildlife as observed during the Remedial Investigation for Tabbs Creek (See Chapter 3).

The forested wetlands at the Center consist of three types: red marple (*Acer rubrum*) swamp, sweetgum (*Liquidambar styraciflua*) swamp, and water oak (*Quercus nigra*) pond wetlands. The red maple swamp wetland is dominated by red maple with some sweetgum. The sweetgum swamp is dominated by sweetgum, with black gum (*Nyssa sylvatica*) and willow *oak (Q. phellos*). The water oak pond wetland is dominated by water oak and laurel oak (*Q. laurifolia*). These wetlands are located primarily along the upper reaches of the Brick Kiln Creek and Tabbs Creek marsh wetlands, and in the undeveloped portion of the LaRC West Area. The forested wetlands may be remnants of a larger wetland area that had been converted to non-wetland by ditches and draining. Shrub-scrub wetlands occur in limited areas, mostly in ditches adjacent to the marsh wetlands. Young red maple, sweetgum, and willow (Salix sp.) characterize the shrub-scrub wetlands.

The wetland mapping from the ODU survey is incorporated into the master Planning maps for LaRC. Center policy is to prohibit development in the marsh wetlands.

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4.2.6 Floodplains

Executive Order 11988 defines a floodplain as "the lowland and relatively flat areas adjoining inland and coastal water including flood prone areas of offshore islands, including at a minimum, that area subject to one percent or greater chance of flooding in any given year." A 100-year floodplain is defined as the area which has a one percent chance of flooding in any given year. Floodplains are delineated by a floodstage elevation on maps prepared by the FEMA.

The stillwater elevation for the 100-year floodplain for the City of Hampton near LaRC is estimated by the FEMA at 8.5 ft (2.6 m) above MSL, while the stillwater level for the 500-year floodplain is 9.8 ft (2.9 m) above MSL (FEMA, 1987) (Figure 4-3). FEMA has estimated 100-year floodwater levels with accompanying waves at about 11 feet (3.3 m) above MSL near the Center. Approximately one-third of LaRC is within the 100-yr floodplain.

The three most destructive hurricanes affecting Virginia in the last century were in 1933, 1954 and 1969. The 1933 hurricane is reported to have caused the water level in the Back River near NASA LaRC to rise to about 8.5 ft (2.6 m) above MSL. In 1992, the ACOE, Norfolk district conducted a Virginia Hurricane Evacuation Study to provide a comprehensive detailed plan for responding to flood threats from major hurricanes. The analysis suggests that the LaRC area may be inundated to different levels, as indicated below, depending on the hurricane intensity:

Hurricane Category	Stillwater level ft above MSL (m)
Category 2	8.8 (2.7)
Category 3	12.5 (3.8)
Category 4	15.6 (4.8)

Therefore, a Category 2 hurricane could produce a water level similar to a 100-year flood in the LaRC area. A Category 3 hurricane may produce a level higher than a 500-year flood event in the area. At such high water levels, a majority of the Center would be under several feet of water.

4.3 MAJOR ENVIRONMENTAL CONSIDERATIONS FOR PROPOSED ACTIONS

The NEPA compliance process, as specified in LAPG 8800.1, should be followed for any proposed action to include a review of the proposed development against the designated floodplain elevations. A wetland or floodplain assessment must be prepared for development proposed in floodplains or wetlands. Projects should be reviewed for coastal zone consistency, and a statement regarding consistency should be included in EAs and EISs. Proposed developments must be coordinated with the EMO.

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5.0 AQUATIC AND TERRESTRIAL BIOTIC RESOURCES

5.1 REGULATORY OVERVIEW

5.1.1 Fish and Wildlife Conservation Act of 1980

The Fish and Wildlife Coordination Act of 1958 (16 U.S.C 661-666c) and the Fish and Wildlife Conservation Act of 1980 (16 U.S.C. 2901 et seq.) were enacted to ensure that states and Federal Agencies conserve and promote the conservation of non-game fish and wildlife and their habitats. A Federal Agency must consult with the U.S. Fish and Wildlife Service, and state wildlife agencies when planning water resource projects involving impoundment, diversion, deepening, modification or control of a body of water. Consultation is necessary to assess the impacts on wildlife resources and possibly modify the plans to prevent loss or damage to such resources.

5.1.2 The Marine Mammal Protection Act of 1972

The Marine Mammal Protection Act of 1972, Public Law 92-522, prohibits the harassment or taking of marine mammals except during commercial fishing, capture under scientific research or public display permits, harvest by Native Americans for food, or other incidental take as authorized on case-by-case basis.

5.1.3 The Migratory Bird Treaty Act and the Migratory Bird Conservation Act

These two acts ensure protection of migratory waterfowl and seabird species that are native to the United States.

5.2 NASA LANGLEY OPERATIONS

NASA LaRC is located in the Coastal Plain of southeastern Virginia. The predominant ecological feature of this region is the Chesapeake Bay. With its extensive open-water areas and associated tidal flats, creeks, and marshes, the Chesapeake Bay is a major migratory flyway, and provides important waterfowl nesting and wintering habitat. Two designated preservation areas in the vicinity of LaRC are the Plum Tree Island National Wildlife Refuge in the City of Poquoson and the North End Point Natural Preserve in the City of Hampton.

In 1973, Boyd and Ware prepared a listing of flora and fauna at NASA LaRC and Langley Air Force Base (LAFB) (Boyd and Ware, 1973). In 1985, the Virginia Herpetological Society published a survey of amphibians and reptiles that may be found in the NASA LaRC area (Tobey, 1985). LaRC has conducted several biological surveys, including wetland surveys (ODU, 1991a,b,c and 1992) and the Tabbs Creek Remedial Investigation (Ebasco, 1995c). In 1993, LaRC contracted with ODU-applied Marine Research Laboratory (ARL) to perform a multi-season baseline survey of the flora and fauna of the Center. The field effort was conducted during 1994 and the survey report was issued in 1995 (ODU, 1995). Additionally, a survey of bald eagles and peregrine falcons at LAFB was conducted in 1994 by Geo-Marine, Inc. under contract with the ACOE (Geo-Marine, 1995).

5.2.1 Terrestrial Flora

LaRC contains approximately 159 acres of natural terrestrial vegetation that can be classified into four categories:

- mixed deciduous/pine forest (94 acres)
- disturbed forest (30 acres)
- pine plantation (18 acres)
- disturbed deciduous forest with brackish influence (17 acres)

Two additional, important terrestrial habitat types--forest edge habitat and open-field habitat--occur at the facility. All but the forest edge habitat, which was not calculated in the ODU (1995) survey, are shown on Figure 5-1. Appendix V-3 is a partial list of plant species occurring at NASA LaRC identified by ODU (1995).

Mixed Deciduous/Pine Forest

The southern portion of the mixed deciduous/pine forest tract is the least disturbed with a 60-to-70-year-old forest predominating. A scattering of individual trees from 100 to 200 years old is present in this section, principally in the wetter portions. The remainder of the tract is composed of forest predominantly 50 to 60 years old, with some 30-year-old sections and a scattering of individual trees over 100 years of age.

In the wetter sections of this forest, the overstory is dominated by sweetgum *(Liquidambar styraciflua*), red maple (*Acer rubrum*), loblolly pine (*pinus taeda*), and American elm *(Ulmus americana*); with cherrybark oak (*Quercus falcatus var. pagodafolia*), green ash *(Fraxinus pennsylvanica*), willow oak (*Quercus phellos)*, and persimmon (*Diospyros virgiana*) as co-dominants. The shrub /sapling layer is dominated by wax myrtle (Myrica cerifera), paw paw (*Asimina triloba*), sweetgum, and red maple; with spicebush (*Lindera benzoin*) and elderberry (*Sambucus canadensis*) as co-dominants. The understory is dominated by honeysuckle (*Lonicera japonica*), poison ivy (*Toxicodendron radicans*), Nepal *microstegium (Eulalia viminea*), and Virginia knotweed (*Polygonum virginianum*); with paw paw, netted chainfern (*Woodwardia areolata*), and false nettle (*Boehmeria cylindrica*) as co-dominants.

In the drier portions of the forest, the overstory is dominated by sweetgum, loblolly pine, red maple, and persimmon; with sassafras (*Sassafras albidum*), shagbark hickory (*Carya ovata*), and black cherry (*prunus serotina*) as co-dominants. The shrub/sapling layer is dominated by paw paw, sweetgum, red maple, and wax myrtle; with American holly (*Ilex opaca*) and dogwood (*Cornus florida*) as co-dominants. The understory is dominated by honeysuckle, Virginia Creeper (*Parthenocissus quinquefolia*), paw paw, and trumpet creeper (*Campsis radicans*); with may apple (*Podophyllum peltatum*), indian hemp (*Apocynum cannabinum*), and beggar's tick (*Desmodium glutinosum*) as co-dominants.

insert figure 5-1

Disturbed Forest

The parcels of disturbed forest range from 30 to 50 years old. The overstory in these parcels is dominated by red maple, sweetgum, loblolly pine, and persimmon; with sassafras, black cherry, and hackberry (*Celtis laevigata*) as co-dominants. The shrub/sapling layer is dominated by wax myrtle, sweetgum, sassafras, and paw paw; with American holly and hackberry as co-dominants. The understory is dominated by honeysuckle, wild onion (*Allium canadense*), and catchweek bedstraw (*Galium aparine*); with ebony spleenwort (*Asplenium platyneuron*), and Virginia knotweed as co-dominants.

Pine Plantation

The pine plantation is approximately 60 years old. The overstory in the drier portions is dominated by loblolly pine with sweetgum and red maple as co-dominants. The shrub/sapling layer is dominated by sweetgum, paw paw, and ironwood (*Carpinus carolinus*). The understory is dominated by honeysuckle and poison ivy. In the wetter portions, the overstory is dominated by hackberry and green ash, sweetgum, tuliptree (*Liriodendron tulipifera*), American sycamore (*Platanus occidentallis*), and red maple as co-dominants. The shrub/sapling layer is dominated by sweetgum and spicebush. The understory is dominated by poison ivy, paw paw, honeysuckle, and jewelweed (*Impatiens capensis*).

Disturbed Deciduous Forest with Brackish Influence

The tracts with brackish influence range from 30 to 50 years old. The overstory is dominated by sweetgum, black cherry, sassafras, and hackberry; with cherrybark oak, loblolly pine, and persimmon as co-dominants. The shrub/sapling layer is dominated by wax myrtle, hackberry, and sassafras, with sweetgum and cherrybark oak as co-dominants. Honeysuckle, blackberry (*Rubus spp*.), trumpet creeper, wild rye (*Elymus virginicus*), and halberd leaf *greenbrier (Smilax bona-nox*) dominate the understory.

Forest Edges

This type of habitat of NASA LaRC represents an ecologically important habitat type. It exists wherever woodland or forest gives way to open field. No acreage of this habitat has been calculated. These forest edges are typically dominated by old field/roadside vegetation. Plant species present in these edge habitats include honeysuckle, ragweed (*Ambrosia artemisifolia*), bushclovers (*Lespedeza spp*.) blackberries (*Rubus spp*.), asters (*Aster spp*.), goldenrods (*Solidago spp*.) thorough-worts (*Eupatorium capillifolium, E. fistulosum*, and *E. coelestinum*), bearsfoot (*Polymnia uvedalia*), and verbesina (*Verbesina occidentalis*).

Open Fields

There are numerous open fields at NASA LaRC; most are relatively small areas between buildings that are mowed too frequently to have any significant habitat value. One open field area that does have significant habitat value is the large open fields

surrounding the Landing Loads Test Facility located in the northern part of the facility. The frequency of mowing here is sufficient to discourage the succession of woody vegetation, and maintains the area in a perpetual early old-field successional stage, dominated by perennial grasses and forbs. Old-field habitats such as this provide nesting habitat for a number of ground-nesting bird species, and foraging habitat for numerous bird and small mammal species.

5.2.2 Terrestrial Fauna

Wildlife species identified by Byrd and Ware in 1973, Tobey in 1985, Geo-Marine in 1995, and ODU-AMRL in 1995 are listed in Appendix V-1. Mammals known to occur at NASA LaRC include white-tailed deer, rabbit, raccoon, squirrels, muskrats, opossums, shrews, and fox. Numerous amphibian and reptile species are common to the area. Numbers species of birds, including waterfowl and wading birds, use the coastal marshes for foraging and/or roosting, including various species of herons, egrets, ducks, gulls, and geese. Species observed in Tabbs Creek include the following: caspian tern, great blue heron, green heron, osprey, herring gull, great egret, white ibis, Virginia rail, plover, killdeer, sandpiper, red-winged blackbird, and grey catbird (Ebasco, 1995c).

5.2.3 Aquatic Vegetation

Four basic aquatic community types were found to occur at NASA LaRC (ODU, 1995) (see Figure 5-1).

Brackish Tidal Marshes

The tidal marshes at NASA LaRC are dominated by saltmarsh cordgrass (*Spartina alterniflora*), seashore saltgrass (*Distichlis spicata*), saltmeadow cordgrass (*Spartina patens*), and needlegrass rush (*Juncus roemeranus*); with alkali bulrush (*Scirpus robustus*) and *fimbry (Fimbristylis spadicea*) as co-dominants. The marsh edges contain sections dominated by common reed (*Phragmites australis*), and occasionally, big cordgrass (*Spartina cynosuroides*). Some marsh edge sections support scrub/shrub communities dominated by eastern false-willow (*Baccharis halimifolia*), wax myrtle, and big-leaf sumpweed (*Iva frutescens*), with winged sumac (*Rhus copallinum*) and chinese privet (*Ligustrum sinense*) as co-dominants. The understory in the scrub/shrub communities are dominated by seaside goldenrod (*Solidago sempervirens*), halberd-leaf saltbush (*Altriplex patula*), and halberd-leaf greenbrier.

Brackish Ponds with Occasional Tidal Influence

A brackish permanent pond located in the northwestern corner of NASA LaRC property contains emergent vegetation dominated by seaside saltgrass, saltmeadow cordgrass, needlegrass rush, and alkali bulrush. The surrounding shrub community is dominated by eastern false-willow, wax myrtle, and big-leaf sumpweed. The understory in this community is dominated by halberd-leaf greenbrief, common greenbrier (*Smilax rotundifolia*), seaside goldenrod, and halberd-leaf saltbush.

A brackish, semi-permanent pond on the north side of the Landing Loads Test Facility, beside the historic Winder-Garrett cemetery, is predominantly freshwater and is normally dry for a short period each year. The dominant emergent vegetation is swamp *rosemallow (Hibiscus moscheutos*) and shoreline sedge (*Carex hyalinolepsis*). In certain portions of the pond, Virginia blueflag (*Iris virginica*) is co-dominant.

Palustrine Freshwater Ponds

The ponds are palustrine forested ponds located in the large contiguous tract of forest along the western side of NASA LaRC. The overstory in these habitats is dominated by willow oaks, laurel oak (*Quercus laurifolia*), red maple, and black gum (*Nyssa sylvatica*). Wax myrtle, paw paw, fetterbush (*Leucothoe racemosa*), and elderberry dominate the shrub layer. The understory is dominated by common greenbrier, poison ivy, cutleaf grapefern (*Botrichium dissectum*), and red maple seedlings, with some ponds co-dominated by netted chainfern, fowl manna grass (*Glyceria striata*), and Elliot's goldenrod (*Solidago ellotii*).

Brackish and Freshwater Ditch Systems

The brackish ditches are primarily located in the northern portion of NASA LaRC and empty directly into Brick Kiln Creek. The emergent vegetation in these ditches is dominated by saltmarsh cordgrass near their northern limits, with seaside saltgrass, alkali bulrush, and common reed co-dominant elsewhere.

The freshwater ditch system drains most of the central and western portions of NASA LaRC. Most of this system drains into the brackish ditches in the northern portion of NASA LaRC and a small portion drains to the east directly into Tabbs Creek. A third freshwater drainage crosses the center of the pine forest in the southeast corner of NASA LaRC. The system empties into the drainage ditch system of the LAFB airfield. The emergent vegetation in most of these ditches is dominated by grass-leaf arrowhead (*Sagittaria graminea*), cespitose knotweed *(Polygonum cespitosum*), Virginia dayflower (*Commelina virginica*), Nepal microstegium, lady's thumb (*Polygonum Persicaria*), and Virginia bugleweed (*Lycopus virginicus*).

5.2.4 Aquatic Species

Tabbs Creek and Brick Kiln Creek are polyhaline tidal creeks comprising intertidal habitats, including mudflats, salt marshes, and shallow subtidal habitats. The diversity of habitats support numerous aquatic and semi-aquatic species, resulting in high rates of primary and secondary production. Tidal creeks are especially important as nursery areas for larval and juvenile fishes. In addition, numerous species of fish and crustaceans use these systems for foraging and refuge. Many of these species are migratory and use tidal creeks on a seasonal basis.

The dominant species of invertebrates of Tabbs Creek observed during the remedial investigation (Ebasco, 1995b) included crustaceans and mollusks, such as blue crab (*Callinectes sapidus*), wharf crab (*Sesarma reticulatum*), fiddler crab (*Uca pugnax*), grass shrimp *(Palaemonetes pugio*), and saltmarsh periwinkle (*Littoraria irrorata*), which

were distributed throughout the Creek in high densities. Eastern oyster (*Crassostrea virginica*) and ribbed mussel (*Geukensia desmissa*) were present only near the confluence of the Creek and the Northwest Branch of Back River, probably as a result of salinity, substrate, and submergence conditions. Juvenile quahogs (*Mercenaria mercenaria*) were the dominant species found throughout Tabbs Creek.

Portions of the Back River near Tabbs Creek are leased for oyster bedding. Oyster catches in recent years have declined, most likely due to the virus MSX and the bacterium Dermocestidium. Shellfishing in, and the consumption of shellfish from, Tabbs Creek and portions of the Northwest and Southwest Branches of Back Creek are prohibited by the Virginia State Department of Health.

The dominant fish species found in Tabbs Creek include mummichog (*Fundulus heteroclitis*), Atlantic menhaden (*Brevoortia tyrannus*), spot (*Leiostomus xanthurus*), and croaker (*Micropogonias undulatus*). A 1975 fisheries survey of the Back River system by the Virginia Institute of Marine Science (VIMS) showed the presence of the following species: bay anchovy (*anchoa mitchilli*), striped anchovy (*anchoa hepsetus*), spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogon undulatus*), oyster toadfish (*Cynoscion regalis*), hogchocker (T*rinectes maculatus*), scup (*Stenotomus chrysops*), silver perch (*Bairdella chrysops*), Atlantic spacefish (C*haetodipterus faber*), pinfish (*Lagodon rhombodies*), lookdown (*Selene vomer*), dusky pipefish (*Syngnathus floridae*), and northern pipefish (*Syngnathus fuscus*) (NASA LaRC, 1979). Appendix V-2 lists aquatic species collected by ODU (ODU, 1995) in waters near NASA LaRC.

5.2.5 Biotic Resource Management and Monitoring

Because there is no regulatory mandate, NASA LaRC does not have an ongoing program for biotic resource management and monitoring.

5.3 MAJOR ENVIRONMENTAL CONCERNS FOR PROPOSED ACTIONS

All construction and ground disturbing projects must be coordinated through EMO, OSEM, so that the potential biological impacts can be assessed. Projects should be sited and designed to promote conservation of flora and fauna and their habitats.

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6.0 ENDANGERED AND THREATENED SPECIES

6.1 REGULATORY OVERVIEW

6.1.1 Endangered Species Act of 1973

The Endangered Species Act of 1973 (16 U.S.C. 1531 through 1543) was enacted "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved [and] to provide a program for the conservation of such endangered species and threatened species." The Act states that "all Federal departments and agencies shall seek to conserve endangered species and threatened species and utilize their authorities in furtherance of this Act."

The term *endangered species* applies to "any species which is in danger of extinction throughout all or a significant portion of its range." The term *threatened species* pertains to "any species which is likely to become an endangered species within the foreseeable future through all or a significant portion of its range." Determination of endangered or threatened species is made by the Secretary of the Interior, or the Secretary of Commerce for species over which the Secretary of Commerce has program responsibilities. The list of endangered and threatened species, and proposed candidates for listing, are published in the Federal Register on an annual basis (50 CFR Part 17).

Section 7 of the Endangered Species Act requires Federal agencies to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species. The Federal agency must consult with the Secretary of the Interior, or Secretary of Commerce where appropriate, to determine if an endangered or threatened species is present in the area of the proposed project (i.e., Section 7 consultation). If such a species might be present, the Federal agency must conduct a Biological Assessment to identify the extent the proposed action will affect this species. The Biological Assessment, which may be undertaken as part of the Federal agency's compliance with the requirements of Section 102 of NEPA (42 U.S.C. 4321), is then submitted to the Secretary of the Interior for a Biological Opinion. Once the consultation has been initiated, the Federal agency cannot make any changes to the proposed action. The Endangered Species Act does not afford protection to species with candidate status; however, the Act does require Federal agencies to consider such species in their environmental planning.

6.1.2 Virginia Endangered Species Program

The Virginia endangered species program is administered jointly by the Virginia Department of Game and Inland Fisheries (DGIF) and the Department of Agriculture and Consumer Services. The Division of Natural Heritage within the Virginia Department of Conservation and Recreation maintains a constantly updated database of Federal- and State-listed species, proposed candidates for Federal listing, and State rare species. The Division of Natural Heritage defines Natural Heritage Resources as rare plant and animal species, rare and exemplary natural communities, and significant geological features. These are identified by the state for ranking protection priorities.

The Poquoson west quadrant Natural Heritage Resources, which include the NASA LaRC area, are listed below.

NATURAL HERITAGE RESOURCES AT POQUOSON WEST					
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**	**State Status**
AMPHIBIANS					
Ambystoma Mabeei	Mabee's Salamander	G4	S1S2		LT
Ambystoma Tigrium	Tiger Salamander	G5	S1		LE
Hyla Gratiosa	Barking Treefrog	G5	S1		LT
BIRDS					
Haliaeetus	Bald Eagle	G4	S2	LT	LT
Leucocphalus	Least Bittern	G5	S2		
Ixobrychus Exilus					
COMMUNITIES	Coastal Plain Depression Pond Low Salt Marsh Salt Scrub Non-Riverine Wet Hardwood Forest				
INVERTEBRATES					
Stygobromas Araeus	Tidewater Interstitial Amphipods	G5	S1		SC
NON-VASCULAR PLANTS					
Sphagnum Macrophyllum Var Macrophyllum	Large-Leaf Peatmoss	G3T3	S2		
REPTILES					
Crotalus Horridus Atricaudatus	Canebrake Rattlesnake	G4TUQ	S1		LE
VASCULAR PLANTS					
Cuscuta Indecora	Pretty Dodder	G5	S2?		
Fimbristylis Perpusilla	Harper's Fimbristylis	G2	S1		LE
Hottonia Inflata	Featherfoil	G4	S2		
Lythrum Lanceolatum	Lance-Leaved Loosestrife	G5T5	SH		
Miterola Periolata	Lax Hornpod	G5	S1		
Sabatia Campanulata	Slender Marsh Pink	G5	S2		
Tillandsia Usneoides	Spanish Moss	G5	S2		
Verbena Scabra	Sandpaper Verain	G5	S2		

Information provided by: Commonwealth of Virginia, Department of Conservation and Recreation

Natural Heritage Ranks

The following ranks are used by the Virginia Department of Conservation and Recreation to set protection priorities for natural heritage resources. Natural Heritage Resources, or NHR's, are rare plant and animal species, rare and exemplary natural communities, and significant geologic features. The primary criterion for ranking NHR's is the number of populations or occurrences, i.e. the number of known distinct localities. Also of great importance is the number of individuals in existence at each locality or, if a highly mobile organism (e.g., sea turtles, many birds, and butterflies), the total number of individuals. Other considerations may include the quality of the occurrences, the number of protected occurrences, and threats. However, the emphasis remains on the number of populations or occurrences such that ranks will be an index of known biological rarity.

S1	Extremely rare; usually 5 or fewer populations or occurrences in the state; or may be a few remaining individuals; often especially vulnerable to extirpation
S2	Very rare; usually between 5 and 20 populations or occurrences; or with many individuals in fewer occurrences; often susceptible to becoming extirpated
S3	Rare to uncommon; usually between 20 and 100 populations or occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances
S4	Common; usually >100 populations or occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats
S5	Very common; demonstrably secure under present conditions
SA	Accidental in the state
SB#	Breeding status of an organism within the state
SE	Exotic; not believed to be native in the state
SH	Historically known from the state, but not verified for an extended period, usually >15 years; this rank is used primarily when inventory has been attempted recently
SN#	Non-breeding status within the state. Usually applied to winter resident species
SR	Reported from the state, but without persuasive documentation to either accept or reject the report
SU	Status uncertain, often because of low search effort or cryptic nature of the element
SX	Apparently extirpated from the state
SZ	Long distance migrant whose occurrences during migration are too irregular, transitory and/or dispersed to be reliably identified, mapped or protected

Global ranks are similar, but refer to a species' rarity throughout its total range. Global ranks are denoted with a "G" followed by a character. Note that GA and GN are not used and GX means apparently extinct. A "Q" in a rank indicates that a taxonomic question exists concerning that species. A "?" in a rank indicates as to that species'

rarity. Ranks for subspecies are denoted with a "T". The global and state ranks combined (e.g. G2/S1) give an instant grasp of a species' known rarity.

These ranks should not be interpreted as legal designations.

Federal Legal Status

The Division of Natural Heritage uses the standard abbreviations for Federal endangerment developed by the U.S. Fish and Wildlife Service, Division of Endangered Species and Habitat Conservation.

LE - Listed Endangered
LT - Listed Threatened
PE - Proposed Endangered
PT - Proposed Threatened
C1 - Candidate, Category 1
C2 - Candidate, Category 2
3A - Former Candidate, presumed extinct
3B - Former Candidate, not a valid species under current taxonomic understanding
3C - Former Candidate, common or well protected
NF - no federal legal status

State Legal Status

The Division of Natural Heritage uses similar abbreviations for State endangerment.

LE- Listed Endangered
LT - Listed Threatened
C - Candidate
PE - Proposed Endangered
PT - Proposed Threatened
NS - no state legal status
SC - Special Consideration

Contact the following agencies for information on the laws pertaining to threatened or endangered species:

- U.S. Fish and Wildlife Service for all Federally listed species.
- Department of Agriculture and Consumer Services Plant Protection Bureau for State listed plants and insects.
- Department of Game and Inland Fisheries for all other State listed animals.

6.1.3 Virginia Endangered Species Act

The Virginia Endangered Species Act (Title 29.1-563) was enacted to provide protection to species of fish and wildlife threatened with extinction in Virginia. The same definitions for endangered and threatened species in the Federal Act apply to the State

Act and provisions for conserving such fish and wildlife species are specified, as well as restriction of the taking, transport, processing, or sale of such species within Virginia. The Act explicitly states that any new Federal listing automatically becomes a State listing; these State-listed species are published in Virginia Regulation 4VAC15-20-130. The Virginia DGIF is responsible for the State endangered species program for fish and wildlife. In addition, Virginia keeps a State listing of species of special concern. The term *species of special concern* refers to any species which is restricted in distribution, uncommon, ecologically specialized, or threatened by other imminent factors.

6.1.4 Virginia Endangered Plant and Insect Species Act

Under the Virginia Endangered Plant and Insect Species Act (Title 3.1-1020 through 3.1-1030), the Board of Agriculture and Consumer Services has established procedures for the conservation of endangered and threatened plant and insect species, and for managing the sale and movement of such species within the State of Virginia. The Act uses the same definitions of threatened and endangered species as the Federal Act, but excludes species determined not to be in the best interests of mankind. The Virginia Department of Agriculture and Consumer Services is responsible for the State endangered species program for plants and insects. All State-listed plants can be found in 2VAC5-320-10.

6.2 NASA LANGLEY OPERATIONS

Old Dominion University (ODU) has conducted facility-wide fish, wildlife, and plant surveys (ODU, 1995). Appendices V-1, V-2, and V-3 contain a complete listing of their findings. A total of 164 plant species were identified at NASA LaRC during this survey. No plants listed as threatened or endangered were found in any of the habitat types at NASA LaRC. Two species were encountered that are rare or uncommon in the area: the maroon Carolina milkvine (*Matalea carolinensis*) and the southern adder's tongue (*Ophioglossum vulgatum*). Appendix V-3 contains a partial list of plant species found at NASA LaRC.

Sixteen species of reptiles and amphibians were identified from NASA LaRC (Appendix V-1) and 19 additional species should occur in the area, but were not encountered during the study. Two reptile species, the canebrake rattlesnake (*Crotalus horridus atricaudatus*) and Kemp's Ridley sea turtle (*Lepidochelys kempi*), are listed by the State as endangered species. Kemp's Ridley sea turtle is also listed as an endangered species by the Federal Government. A third species, the Eastern glass snake (*Ophisaurus ventralis*), is listed on the State list as a threatened species. In addition, three northern diamondback terrapins (*Malaclemys terrapin terrapin*), a Federal species of concern, were captured, identified, and released (ODU, 1995).

Fourteen species of mammals were encountered at NASA LaRC during the ODU survey (Appendix V-1), and 12 additional species are expected to occur. None of these mammals are listed as threatened or endangered; however, three of the species found to inhabit NASA LaRC are listed as species of special concern by the Commonwealth of Virginia--the river otter (*Lutra canadensis*), the marsh rabbit (*Sylvilagus palustris*), and the small star-nosed mole (*Condylura cristata parva*).

A total of 118 species of birds were observed at NASA LaRC during the survey (Appendix V-1). Of these, 7 are listed as threatened or endangered by the State or Federal government and 17 more are listed as species of special concern in the Commonwealth of Virginia. The bald eagle (*Haliaeetus leucocephalus*), gull-billed tern (*Sterna nilotica*), and the Henslow's sparrow (*Ammodramus henslowii*) were determined to be transient migrants who use the NASA LaRC facility solely as a foraging stop. The northern harrier (*Circus cyaneus*), brown creeper (Certhias americana), winter wren (*Troglodytes troglodytes*), hermit thrush (*Catharus guttatus*), and the purple finch (*Carpodacus purpureus*) have the potential to nest at NASA LaRC, though currently none of them do. In addition, the brown pelican (*Pelicanus occidentalis*), least tern (*Sterna antillarum*), and great egret (*Ardea alba egretta*) are unlikely to nest at NASA LaRC due to lack of suitable nesting habitat. Although not sited during the ODU survey of NASA LaRC, the peregrine falcon (*Falco peregrinus*), a Federal endangered species, was sited at adjoining LAFB during a survey of the base in 1994 (Geo-Marine, 1994). This species uses the base (and presumably parts of NASA LaRC) primarily for foraging; no nesting or long-term roosting was found.

Thirty-three finfish species were collected at NASA LaRC during the ODU study (Appendix V-2). All species were common to the lower Chesapeake Bay and its tributaries. No endangered, threatened, or special concern species inhabit or use the NASA LaRC community. Table 6-1 summarizes the Federal- and State-listed endangered, threatened, and special concern species for the wildlife found at NASA LaRC.

6.3 MAJOR ENVIRONMENTAL CONSIDERATIONS FOR PROPOSED ACTIONS

All construction and ground-disturbing projects must be coordinated through EMO so that potential impacts to endangered, threatened, or special concern species can be assessed. EMO should consult with the USFWS (United States Fish & Wildlife Service) under Section 7 of the Endangered Species Act and with the State Department of Game and Inland Fisheries under Article 6 (§29.1-563 et seq.) of Chapter 5 of Title 29.1 of the Code of Virginia as appropriate.

Table 6-1
THREATENED, ENDANGERED, or SPECIAL CONCERN SPECIES at NASA LaRC

Species	Federal	State
Mammals		
Marsh rabbit		SSC
River otter		SSC
Small star-nosed mole		SSC
Reptiles		
Canebrake rattlesnake		SE
Eastern glass lizard		ST
Kemp's Ridley sea turtle	FE	
Northern diamondback terrapin	SOC	
Birds		
Bald eagle	FT	SE
Barn-owl		SSC
Black rail	SOC	
Brown creeper		SSC
Brown pelican		SSC
Caspian tern		SSC
Forster's tern		SSC
Glossy ibis		SSC
Golden-crowned kinglet		SSC
Great egret		SSC
Gull-Billed tern		ST
Henslow's sparrow	SOC	ST
Hermit thrush		SSC
Least tern		SSC
Little blue heron		SSC
Loggerhead shrike	SOC	ST
Magnolia warbler		SSC
Peregrine falcon		SE
Piping plover	FT	
Purple finch		SSC
Red-breasted nuthatch		SSC
Sharp-tailed sparrow		SSC
Wilson's plover		SE
Winter wren		SSC
Yellow-crowned night-heron		SSC

Notes: FE = Federal Endangered FT = Federal Threatened SOC = Federal Species of Concern (not a legal status) SE = State Endangered ST = State Threatened SSC = State Special Concern (not a legal status)

Source: Virginia Department of Game and Inland Fisheries, 2000

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7.0 HAZARDOUS AND SOLID WASTE

7.1 REGULATORY OVERVIEW

7.1.1 Resource Conservation and Recovery Act (RCRA)

The Resource Conservation and Recovery Act, passed by Congress in 1976, is the law under which the EPA regulates all aspects of waste management from generation to ultimate treatment, storage, and disposal. With several amendments, including the Hazardous and Solid Waste (HSWA) Amendments of 1984, RCRA and its subsequent regulations govern solid waste recycling and disposal; federal procurement of products containing recycled materials; waste minimization; hazardous waste generators transporters; treatment, storage and disposal facilities (TSDFs); and underground storage tanks (UST's).

7.1.1.1 Solid and Hazardous Waste

RCRA "solid waste" is defined as "any garbage, or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities." Certain requirements under RCRA and subsequent Executive Orders require Federal agencies to recycle various solid wastes, practice source separation of solid wastes and purchase products that have recycled content.

RCRA defines "hazardous waste" as a subset of the broader category of "solid waste." A material cannot be a RCRA hazardous waste unless it is first a RCRA solid waste. See LAPG 8800.1, Chapter 5, Waste Management and Minimization for a detailed definition of a RCRA Hazardous Waste.

7.1.1.2 Waste Minimization

Minimization of hazardous waste is required under RCRA. To encourage waste minimization nationwide, the EPA developed the Waste Minimization National Plan (WMNP), which focuses on reducing the generation and subsequent release to the environment of the most persistent, bioaccumulative, and toxic chemicals in hazardous wastes. The WMNP established three goals:

1. Reduce the presence of the most persistent, bioaccumulative, and toxic chemicals, 25% by the year 2000, and 50% by the year 2005;
2. Avoid transferring these chemicals across environmental media; and
3. Ensure that these chemicals are reduced at their source whenever possible, or, when not possible, that they are recycled in an environmentally sound manner.

7.1.1.3 Underground Storage Tanks

In response to the growing number of leaking Underground Storage Tanks throughout the U.S., Subtitle I was added to RCRA to include provisions governing design and installation of UST's, release detection, release response, corrective action, financial responsibility, and closure. Information on LaRC's USTs can be found in Chapter 11, Aboveground and Underground Storage Tanks.

7.1.2 Virginia Department of Environmental Quality (VDEQ)

The VDEQ Waste Management Division administers nonhazardous (including infectious waste) and hazardous waste programs. In 1984, the VDEQ was granted authorization to administer Virginia's hazardous waste program and its subsequent regulations for treatment, storage, disposal, and transportation of hazardous waste. The VDEQ also has authorization to administer the Hazardous and Solid Waste Amendments (HSWA) of 1984, which includes the corrective action program. The State requirements for cleanup activities relies on EPA regulations found in 40 CFR Part 300. The VDEQ also administers Virginia's UST Program that was approved by the EPA in December of 1998.

7.2 NASA LANGLEY OPERATIONS

7.2.1 Solid Waste Disposal

NASA LaRC's mission results in the generation of significant volumes of municipal solid waste. The major items are: paper (white and mixed); wood; metals (copper, aluminum, steel, and specialty metal); cardboard and paperboard products; plastics; grounds maintenance waste food wastes (cafeteria); glass, specialized materials (composites, plastics, ceramics, and alumina); and remediation and facility maintenance wastes (debris, rags, absorbants).

Scrap metals such as aluminum, copper and steel, and excess materials having salvage value are given to a contractor who brokers the material for LaRC. Scrap materials of little or no value such as building materials, tree and shrub trimmings, and broken concrete are transported to a licensed landfill for disposal. Excess equipment is given to the General Services Administration (GSA) to be recycled to private vendors for resale.

Approximately 580 tons per year of LaRC solid waste is burned in the Refuse-Fired Steam-Generating Facility (RFSGF) located on Wythe Creek Road. The waste is general facility trash that is not recyclable. The plant has the capacity to burn 200 tons per day of refuse from the City of Hampton, NASA LaRC, LAFB, Fort Monroe, Bethel Manor Housing, and the Veterans Administration Hospital. In the event that the RFSGF closes down operations, LaRC may send its solid waste to a local landfill.

Infectious wastes at LaRC are generated at the Health Clinic located at Building 1149. LaRC has an Infectious Medical Waste Management Plan and wastes are managed

according to a Permit-by-Rule as allowed under a provision in Virginia regulation 9 VAC 20-120-160 Part 4.1. The Health Clinic generates less than fifty pounds of waste each year. Several times throughout the year, the wastes are properly packaged in burn boxes and sent to the LAFB incinerator which is permitted to burn infectious material.

The EMO tests paint removal and spill cleanup wastes to ensure that the materials are properly disposed of. Wastes that are nonhazardous, nonregulated solid materials are consolidated into dumpsters and sent for disposal to a local landfill. Remediation and spill debris material that contain RCRA listed hazardous waste or exhibit hazardous characteristics are sent to a permitted hazardous waste disposal facility.

7.2.2 Solid Waste Recycling

The overall objective of LaRC's recycling program is to develop an efficient and cost effective recycling program that meets the following goals:

- Meet or exceed the recycling goals established by E.O. 13101.
- Maximize collection of recyclables and proceeds from their sale.
- Preserve and conserve the environment and its resources.

Tables 7-1 and 7-2 provide a summary of the recycling activities at the Center. These recycling activities result in returned income to LaRC to be used for pollution prevention and recycling initiatives.

Table 7-1
SUMMARY of RECYCLING ACTIVITIES at NASA LaRC

Material	Collection Method
PAPER, CARDBOARD, TONER	Collected throughout the Center by the EMO support contractor for recycling and rebate.
OIL FILTERS (from vehicle maintenance)	Collected by vehicle maintenance personnel and shipped off site for recycling.
OIL (Synthetic/Phosphate Ester)	Collected in drums, consolidated by the EMO support contractor and shipped off site for recycling and rebate.
METAL (Scrap aluminum, copper, ferrous metals)	Sorted by type and collected in drums and hoppers. Contractor brokers the metal for LaRC.
FLUORESCENT BULBS	Collected by electrical support contractor. Shipped off site by EMO for complete recycling.
BATTERIES (Lead acid, Nickel cadmium)	Accumulated in containers. Collected by the EMO and shipped off site for recycling.
ORGANICS (Yard waste)	Grass clippings are left on the lawn. Some leaves are collected and are composted.
ANTIFREEZE (Used, drained from vehicles)	Collected by Vehicle Maintenance Facility and recycled on-site using a portable recycling unit.

Table 7-2
LaRC Recycling Metrics for FY 1998-2000

Type of Material	FY 1998 (lbs.)	FY 1999 (lbs.)	FY 2000 (lbs.)
Aluminum	0	9 ,050	195
Antifreeze	2,145	858	858
Batteries	4,536	9,565	3,230
Cardboard	56,280	50,860	49,940
Copper (incl. copper wire)	0	4,242	9,130
Ferrous Metals	896,150	397,800	382,980
Fluorescent Tubes	10,388	9,542	10,587
Mixed Paper	72,600	60,900	63,840
Toner Cartridges	1,789	1,444	1,557
Used Oil	98,598	35,440	64,660
White Paper	251,900	199,780	193,780
Total	**1,394,386**	**779,481**	**780,757**

7.2.3 Hazardous and Regulated Waste

LaRC is a generator of hazardous waste under EPA Permit Number VA2800005033. The Center is not authorized to transport hazardous waste off site, store hazardous waste beyond a 90-day accumulation period, or dispose of hazardous on site. LaRC uses appropriately permitted contractors to transport wastes from the 90-day Hazardous Waste Pre-Transport Facility, Building 1166, to off-site disposal facilities.

7.2.3.1 Hazardous and Regulated Waste Generation

LaRC generates a wide variety of wastes including gases, solvents and fuels, photochemicals, metals and polymers from research, and fluorescent light bulbs. LaRC also generates TSCA regulated and special wastes such as asbestos, transformer oils, and PCB capacitors. See Chapter 8, Toxic Substances for TSCA information.

Table 7-3 presents a summary of *regulated* waste disposal and Table 7-4 shows a summary of *hazardous* wastes generated at LaRC for fiscal years 1998 through 2000.

Table 7-3 REGULATED WASTE DISPOSAL (lbs.) FY 1998-2000			
Type of Waste	1998	1999	2000
Asbestos (pipe insulation, tile, mastic, transite panels, adhesives, lined ovens, file cabinets).	62,000	40,000	8,251*
PCB Material (light ballasts, capacitors, and small transformers).	6,823	7,057	6,702
Transformer Oil (50 ppm and greater PCB drained from transformers, shipped by tanker truck)	38,239	110,230	0
Totals	107,062	181,287	14,953

*Does not include asbestos disposed of by projects performed by off-site contractors.

Table 7-4 HAZARDOUS WASTE DISPOSAL (lbs.) FY1998-2000			
Type of Waste	1998	1999	2000
Aqueous Cleaning Solutions, Corrosive/Metals	0	605	574
Batteries	3,505	5,088	3,317
Clean up Debris	158	0	252
Compressed Gas	1,360	451	478
Contaminated Oil	619	1,496	1,185
Contaminated/Unused Fuel	4,105	3,354	2,124
Flammable/Toxic Solvents from Facility Painting	7,581	4,945	3,000
Flammable Spent Solvents from Cleaning	1,061	1,979	0
Lab Packs Acute/Toxic	0	5	0
Lab Packs Old Chemicals	717	1,216	6,814
Lab Packs Mixed Chemicals	10,347	10,676	2,904
Metals from Lab Research	68	4	1
Lead Paint Remediation Waste	27,547	11,872	7,603
Halogenated Cleaning Solvents	439	0	01,186
Spent Photochemicals	701	364	171
Out of Date Materials	584	0	0
Oily Water	1,411	0	0
Fluorescent Lamps for Recycling	8,260	10,440	11,118
Halogenated/Nonhalogenated Lab Solvents	2,987	3,643	2,378
Total Hazardous Waste Disposal (lbs.)	71,292	56,138	43,544

7.2.3.2 Hazardous and Regulated Waste Management

NASA LaRC is considered a large-quantity generator of hazardous waste and has operated the less than 90-day Hazardous Waste Storage Facility at Building 1166 since 1991. In addition, NASA LaRC operates over 90 satellite accumulation areas (SAAs) located in various facilities throughout the Center. A current list of SAAs is maintained by the EMO.

Hazardous wastes are picked up from the SAAs and transported by the EMO to Building 1166 for packaging and storage. Every 80-85 days, the waste is shipped off site for disposal at an appropriately permitted disposal facility. For additional information regarding the Center's waste management procedures, refer to LAPG 8800.1, Chapter 5, Waste Management and Minimization.

In the case where there are unknown or questionable wastes are turned in for disposal, the EMO will obtain samples of the material and have it analyzed off site by a qualified environmental laboratory. Once the waste constituents are identified, the material is properly labeled for disposal.

Used oils are consolidated on site and sold to a permitted oil recycler. Drums of oil that are turned in to EMO are first field-tested and if acceptable, the oil is pumped into a 5,000-gallon storage tank located at Building 1166. Prior to shipment, the tank is tested to ensure that it is recyclable quality.

Asbestos waste generated from removal projects at the Center is properly packaged and placed into closed top dumpster containers. The dumpsters are shipped off site by either EMO or the remediation contractor to a permitted asbestos landfill.

Gas cylinders generally are leased under contract from off-site suppliers or purchased under certain circumstances. Empty cylinders are either refilled or devalved and sold as scrap metal.

The EMO is responsible for reviewing and signing all manifests and shipping documents associated with LaRC waste disposal.

Any Transfer, Storage and Disposal Facility (TSDF) used for the disposal of LaRC generated hazardous waste must be approved through a NASA TSDF Audit. The EMO environmental support contractor maintains the approved TSDF list and ensures that LaRC's hazardous waste is properly disposed of at an approved facility.

7.2.4 Waste Minimization

NASA LaRC's policy is to minimize the volume and toxicity of wastes generated by mission operations to the extent technically possible and economically feasible. Source reduction, recycling, recovery and reuse are utilized whenever possible. LaRC has implemented the following procedures that all facility personnel and contractors are expected to follow:

- Review purchase orders to verify quantities of hazardous materials ordered are reasonable and to determine if less hazardous material can be used.

- Continuously review operations to assure that they are conducted efficiently, reducing hazardous material use whenever possible.

- Determine if hazardous wastes generated can be reused.

- Segregate wastes so that non-hazardous wastes do not become contaminated.

Each year, the EMO reviews hazardous waste records for waste generated the previous year. The records are broken down by Organization and a Waste Minimization Report is sent to the respective organizations and divisions. They in turn are responsible for implementing minimization procedures (if possible) that will reduce their hazardous waste. Funds from the sale of recyclable solid wastes are available to help pay for implementation of waste minimization and pollution prevention initiatives.

7.3 MAJOR ENVIRONMENTAL CONSIDERATIONS FOR PROPOSED ACTIONS

All construction and testing operations must be coordinated through the EMO so that environmental impacts can be properly assessed. Contact with the EMO is necessary to ensure that no proposed actions jeopardize compliance with RCRA and State regulations. The following is a summary of regulatory considerations for solid and hazardous waste management:

- Will any new action under consideration generate solid waste and if so, is it RCRA hazardous?

- Will the new action result in changes to currently used methods to treat, store, or dispose of solid waste or result in changes in the quantity or types of wastes generated?

- Will the project recycle materials, change either the volume or type of materials recycled, or change the methods used for recycling? Has it been determined whether these materials to be recycled are solid or hazardous waste regulated under RCRA and whether this activity must be reported to EPA or the State?

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8.0 TOXIC SUBSTANCES

8.1 REGULATORY OVERVIEW

The Toxic Substances Control Act (TSCA) of 1976 is currently administered by the EPA's Office of Pollution Prevention and Toxics (OPPT). Title I of the Law regulates the production and distribution of commercial and industrial chemicals in the U.S. and ensures that the chemicals do not pose any adverse risks to human health or the environment. TSCA requires that any chemical that reaches the consumer marketplace be tested for possible toxic effects prior to commercial manufacture. In addition, Subchapter I bans the production and distribution of polychlorinated biphenyls, and regulates proper disposal and management of any remaining PCB's.

Title II of the Law regulates asbestos to include requiring inspections for asbestos-containing material, establishing an accrediting program for persons involved in asbestos identification and abatement, and implementing response actions for cleanup and removal of asbestos.

Title III of TSCA regulates radon and sets a national goal for radon levels in buildings so that air within the buildings should be as free of radon as the ambient air outside the buildings. Implementing radon programs, training and public awareness are also included in the regulations.

TSCA supplements other federal statutes, including the Clean Air Act and the Toxic Release Inventory under EPCRA.

8.2 NASA LANGLEY OPERATIONS

TSCA's primary applicability at NASA LaRC relates to the removal and disposal of Polychlorinated Biphenyl (PCB)-contaminated equipment, the management of building materials and pipes that contain asbestos, and indoor radon abatement.

8.2.1 Polychlorinated Biphenyls

LaRC requires that all fluids and equipment containing any percentage of PCBs must be carefully controlled and monitored. LaRC has completed the retrofilling or replacement of the fluid in electrical equipment that is greater than 50 ppm PCB, with fluids that are non-PCB. Facilities located throughout the Center still have small light ballasts in them that could contain greater than 50 ppm PCB.

EMO maintains primary responsibility for the management of PCB and non-PCB material at NASA LaRC. The Center retains a maintenance contractor to inspect and service electrical equipment and to respond to any leaks or spills. Another contractor is responsible for the storage and disposal of PCB material, such as light ballasts, and for PCB sampling and analysis. EMO reviews and signs all shipping documents related to PCB material to ensure that an approved disposal facility and proper packaging and transportation are used. Disposal records are maintained by the EMO.

As part of its continuing environment enhancement effort, NASA LaRC has completed cleanup of leaking hydraulic systems containing hydraulic fluids with PCBs and PCTs. PCB contamination was identified in soils at the Area E Warehouse (Ebasco, 1992a); however, because of the low levels of contamination, no cleanup action was required. Spills and leaks from past operations had resulted in contamination of stormwater sewers discharging from Outfall #9 to Tabbs Creek. NASA LaRC completed cleanup of these storm sewers in early 1995. NASA LaRC completed cleanup of PCB and PCT contamination of Tabbs Creek in May 2000. In the East Area, several storm sewers had been found to be contaminated with PCBs from NASA LaRC operations (Ebasco, 1993b). The affected storm sever lines were cleaned to remove PCB and PCT in the sediment. The cleanup was completed in December of 1996.

The Center has a PCB Management Spill Prevention Countermeasure and Control Plan that is maintained by the EMO. Additional information regarding management and disposal of PCBs at the Center can be found in LAPG 8800.1, Chapter 6, Polychlorinated Biphenyl Management.

8.2.2 Asbestos

It is NASA LaRC policy to comply with all Federal and State regulations applicable to asbestos. It is not Center policy to remove or implement other abatement techniques simply because asbestos is present in a building unless the condition of asbestos is such that the health of the building occupants is jeopardized. If a health hazard is found to exist, prompt and effective action is taken. The Center has a continual inspection program of each facility to determine the presence of asbestos-containing building materials (ACBM). The LaRC Safety Office maintains records of asbestos operations and sampling reports.

An Operations and Maintenance (O&M) program is required for each LaRC facility where ACBMs are identified. The principal objective of the O&M program is to minimize the exposure of facility occupants to asbestos. The program includes posting warning signs at buildings that have asbestos, notifying building occupants of the location of the asbestos, periodic inspections, and training for all personnel, including janitorial and custodial staff, who conduct activities that may expose them to asbestos fibers.

NASA LaRC ensures appropriate disposal of all removed asbestos either through its project management group or by requiring evidence of proper disposal for all contracted operations. EMO is responsible for reviewing and signing all asbestos shipping documents prior to shipment off the Center, to ensure that the proper documentation and permitted landfills are being used.

Additional information about asbestos management and disposal at LaRC can be found in LAPG 8800.1, Chapter 8, Asbestos., and LAPG 1740.3, Section 6.5, Asbestos Configuration Management.

8.2.3 Radon Management

In 1990, LaRC participated in the NASA Radon Monitoring Study that was conducted at thirteen NASA installations. LaRC monitored 21 of its own buildings for radon gas. The highest readings were detected in Building 1169 (2.1 picocuries per liter). Since the lowest action level in the NASA Radon Monitoring Plan is 4 picocuries per liter, LaRC was not required to take any action.

8.3 MAJOR ENVIRONMENTAL CONSIDERATIONS FOR PROPOSED ACTIONS

The following are regulatory considerations for proposed projects at LaRC involving chemical substances that are regulated under TSCA:

- Will any new action result in the handling or disposal of PCBs or other substances regulated under TSCA?

- Will any new action impact areas at NASA LaRC already identified as having Asbestos Containing Material?

If any of these considerations apply to the proposed project, the EMO should be contacted to discuss any measures needed to ensure TSCA compliance. Additionally, contact should be made with the EMO if assistance is needed in making these determinations. All construction and testing operations must be coordinated through the EMO so that environmental impacts can be properly assessed.

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9.0 INSECTICIDES AND HERBICIDES

9.1 REGULATORY OVERVIEW

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was passed in 1947 primarily as a consumer protection statute to regulate the manufacture, sale, distribution, and use of pesticides. The Act required that pesticides must be registered with the U.S. Department of Agriculture (USDA) before they could be marketed in interstate commerce. In addition, a label, with manufacturers name and address, name, brand and trademark of the product, net contents, ingredient list, warning statement to prevent injury, and directions for use was required to ensure safe use.

Since 1947, FIRFRA has been amended many times. These amendments include requiring that all pesticide labels contain a Federal Registration Number and caution words such as, "warning", "danger", "caution", "keep out of reach of children", and requiring that manufacturers remove all safety claims from the labels. The authority for FIRFRA was transferred from the USDA to the Environmental Protection Agency (EPA) in 1970. The EPA currently has the authority to regulate pesticides to prevent unreasonable adverse effects on the environment (40 CFR Parts 150-189). There are also OSHA occupational pesticide standards at 29 CFR Part 1910.

A 1994 White House Memorandum, *Environmentally and Economically Beneficial Practices on Federal Landscaped Grounds*, promotes practices that minimize the adverse effects of landscaping on the local environment. Federal agencies are encouraged to reduce their need for fertilizer and pesticides and adopt Integrated Pest Management (IPM) practices. IPM involves using biological and natural controls to manage pests, such as proper plant selection, correct mowing height, and periodic pruning.

Under the Endangered Species Act, federal agencies must ensure that any action they carry out or authorize is not likely to jeopardize the continued existence of any species listed on the Endangered Species List, or to destroy or adversely modify an endangered specie's critical habitat. Registration of pesticides and their use under FIFRA is required to ensure that endangered species are not jeopardized.

At the State level, pesticide policy is delegated primarily to the Virginia Pesticide Control Board at 2VAC20-10-10. The Virginia Pollutant Discharge Elimination System (VPDES) permit program may also require monitoring of pesticide pollutants in stormwater discharges at permitted facilities.

9.2 NASA LANGLEY OPERATIONS

LaRC's policy regarding the use of pesticides is to follow IPM practices whenever possible. Much of the Center's land and foliage is allowed to grow naturally, without any fertilizer or pesticide applications. Grass clippings are returned to the lawn to restore important nutrients. Trees and shrubs are periodically pruned and dead or diseased limbs are discarded. The wetland, forest and forest edge landscapes of LaRC have

varieties and species of plants and trees that are suitable to and thrive in this area. Of the Center's 808 total acres of land, less than one-twentieth of one percent is treated on an as needed basis with pesticides and applications are limited to minimal quantities.

A contractor manages the pesticide program at NASA LaRC. Pesticides include insecticides, herbicides, rodenticides, termiticides and avicides. The contractor uses only EPA approved/registered pesticides only upon approval and issuance of a NASA safety permit for the use of potentially hazardous materials. The pesticides are mixed, stored and applied according to their current Federal use restrictions. As required by law, records of restricted use pesticides are maintained by the contractor. IPM practices are used by the contractor wherever possible and application is performed or supervised by State-certified applicators and/or registered technicians.

General pest control at LaRC is performed by way of service request and involves the mitigation of cockroaches, water bugs, ants, rodents, fleas, mites, spiders, wasps and other arthropoda. Wood destroying pest control, animal and bird control, ornamental and turf pest control are other operations performed by the contractor on an as needed basis.

The contractor also performs scheduled and preventative maintenance pesticide application at LaRC. Buildings 1213, 1222 and 1202 food processing areas are treated on a twice-monthly preventative maintenance schedule. During lawn repair work, where initial grass seeding is required, fertilization takes place and is generally limited to areas less than 5,000 sq. ft. A balanced fertilizer, such as formula 10-10-10 is broadcast in a granular form at an established rate of 10 lbs/1,000 sq. ft. Herbicide application provides non-crop control of emerged annual and perennial weeds with glyphosate used exclusively. Selective equipment includes a 100 gallon spray tank utilized for treating areas that include fence lines, right of way, outdoor electrical substations and large gravel fenced enclosures. Application rates are based on product label recommendations. NASA LaRC uses between 800 and 1000 gallons of diluted herbicide per year.

Pesticides and application equipment are stored in locked cabinets at Building 1285. This building is within the 100-year floodplain. EPA guidelines recommend that "when practicable, [the storage facility] should be located where flooding is unlikely" (40 CFR 165). However, these guidelines are mandatory only for EPA's own operations and not those of other agencies. By location, the NASA LaRC facility is susceptible to floodwaters of a 100-year frequency storm. However, continued practice of shelved storage of containers should minimize potential problems due to floodwaters.

A second contractor is responsible for treating the cooling tower water at LaRC. Treatment includes the application of various chemicals, some of which are algaecides. Algaecides are included in the definition of pesticides as stated in FIFRA 2(t) and 2(u) and the Virginia Pesticide Control Act; therefore, the contractor's operations are regulated by FIFRA and State regulations.

Contractor employees are trained and certified by the manufacturer to apply the algaecides and other treatment chemicals. Some facilities have pumping systems that

continually feed the cooling tower water with the chemicals while other towers require manual feeding. The contractor on a daily, weekly, and monthly basis maintains application records. The algaecides are registered and properly labeled with warnings. Weekly cooling tower sampling is performed by the contractor and the chemical analysis is conducted by personnel at Building 1215.

Since the larger cooling towers require higher volumes of algaecide, the algaecide is stored at each individual location. Containers are appropriately staged within dikes at each storage location. A centralized chemical storage facility that is utilized for the treatment of small cooling towers is located in Building 1156. Since the containers are refilled by the manufacturer (and often refilled by water treatment personnel, disposal of empty containers is not necessary.

9.3 MAJOR ENVIRONMENTAL CONSIDERATIONS FOR PROPOSED ACTIONS

If any proposed action would alter the planned use of chemicals stored on site, the Environmental Management Office (EMO) shall be contacted. Additionally, if a proposed action involves increased application of pesticides at NASA LaRC or application of a new pesticide, the EMO shall be contacted. All construction and testing operations must be coordinated through the EMO so that environmental impacts can be properly assessed.

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10.0 RADIOACTIVE MATERIALS AND NON-IONIZING RADIATION

10.1 REGULATORY OVERVIEW

The Occupational Safety and Health Administration (OSHA) regulates radiation and high radiation areas for the work place in 29 CFR 1910.96. Radiation areas are based on a major portion of the body being exposed to a radiation dose in excess of five millirem per hour or in excess of 100 millirem for five consecutive days at 12 inches. High radiation areas are accessible areas where a major portion of the body could receive a radiation dose in excess of 100 millirem per hour. The above doses are not averaged; they refer to exposure in any one hour at 12 inches.

10.2 NASA LANGLEY OPERATIONS

As part of the NASA LaRC Safety Manual, LaRC has developed a procedure guide that implements the Nuclear Regulatory Commission (NRC), OSHA, and other Federal regulations governing ionizing radiation sources. LAPG 1710.5 assigns responsibilities and authorities for radiological health and safety at NASA LaRC. The guide also covers ionizing sources not covered by NRC regulations and defines procedures and requirements for procurement, use, handling, storage, shipment, and disposal of sources of ionizing radiation, as well as personnel monitoring and emergency procedures. A similar guide, LAPG 1710.8, implements NASA's internal regulations governing non-ionizing radiation sources at the Center. NASA LaRC has identified a Radiation Safety Officer for the Center who is assigned to the LaRC Office of Safety and Facility Assurance.

10.2.1 Ionizing Radiation Sources

Table 10-1 summarizes ionizing radiation sources at NASA LaRC by source and building location. Individual radiation sources vary in strength from 900 millicurie (mCi) to less than 0.1mCi. The NASA Radiation Safety Officer (RSO) monitors these sources and maintains compliance with Federal and State permitting requirements. LaRC holds a NRC license (No. 45-01052-21, expiration date 2005) for laboratory equipment currently operated by LaRC and contractor personnel.

10.2.2 Non-Ionizing Radiation Sources

Non-ionizing radiation sources at NASA LaRC comprise laser research centers and use of laser technology in flow visualization, velocity measurements, and atmospheric and space research. Table 10-2 provides an inventory of non-ionizing radiation sources at NASA LaRC. The sources are inventoried and controlled by LaRC using an internal permit system. The sources usually vary in strength from 5 to 500 milliwatts. The sources are considered to have limited hazard potential and are all used in the Center research activities. NASA, through the Center's Radiation Safety Officer, coordinates its space and atmospheric research activities with the Federal Aviation Administration (FAA) and LAFB to ensure the safety of aircraft in the area during such activities.

Table 10-1
Ionizing Radiation Sources

Permit No. (LaRC Internal)	Source/Operation	Type of Use	Building No.
IR-03	X-Ray Of Composite Specimens	Stress Test	1205
IR-05	Industrial X-Ray System	Analysis	1296
IR-09	X-Ray Radiographic Facility	Stress Test	1205
IR-11	Materials Testing Using Secondary Emission Spectrometer & Diffraction Unit	Analysis	1232A
IR-26	Portable X-Ray Fluorescense Spectrometer Research	Analysis	1271
IR-35	X-Ray Diffraction System W/ Vertical Goniometer, Pole-Figure Device & Kratky Camera	Analysis	1205
IR-42	X-Ray NDE Testing For Component Verification And Location Of Welds On Insulated Piping	Non-Destructive Testing	Centerwide
IR-48 Not active	X-Ray Testing Of Specimens	Stress Test	1230
IR-50	An X-Ray System (Quest) For Quantitative Experiments Utilizing Stresstomography.	Stress Test	1230B
IR-52	Powder Line Polymer Detection Source(Am-241)	Analysis	1293C
IR-54	X-Ray Fluorescence (Dispersive Energy) - Quality Assurance Lab.	Analysis	1245
IR-55	Utilization Of A Radiographic System Employing Reverse Geometry X-Ray	X-ray Diffraction	1230
IR-56	X-Ray Diffraction Studies	X-ray Diffraction	1238A
IR-57	X-Ray Diffraction System	X-ray Diffraction	1205
IR-58	Medical x-ray usage	Medical	1149
IR-59	Gas & aerosol monitoring sensor craft CCDS utilizing Fe-55 source	Characterization Research	1202

Source: NASA LaRC, RSO, 2001

Table 10-2
Non-Ionizing Radiation Sources

Permit No. (LaRC Internal)	Source/Operation	Bldg No.
NIR-007	Fluid Velocity Measurements @ 14x20 Metertunnel W/Laser Velocimeter	1212C
NIR-018	Laser Raman Gas Density & Temp. Lab Exp. Measurement	1200
NIR-041	Relief Velocity Measurements of the flow in the TJF	1221C
NIR-042	Laser Operations For Lidar & Dial Lidar Research	1250
NIR-052	Fluorescence And Flame Temp. Studies	1200
NIR-063	Supersonic Coannular Jet Plume Evaluation	1221A
NIR-137	Laser Velocimeter For Chem. Vapor Deposition	1202
NIR-175	Atmospheric Lidar Measurements	1273
NIR-180	Flow Visualization Tests 12 ft. Speed Tunnel	644
NIR-191	Laser Vapor Screen Test	1251
NIR-192	Infrared Laser Interferometry Lab	1148
NIR-198	Laser Induced Fluorescence Experiments Using UV Eximer Laser	1200
NIR-200	Particle Image Velocimetry Using Two Pulsed Yag Lasers	1247B
NIR-202	Staging Area to Check Laser System in Facility	1221C
NIR-203	Utilization Of A Gigahertz Transverse Electromagnetic Test Cell (Gtem)	1220
NIR-209	3-Component Velocimetry & Laser Light Sheet Studies Of Various flow fields	1214
NIR-213	Laser And High Power Light Source Development For Sensing, Altimetry, and Spectroscopy	1202
NIR-246	Error Analysis & General R&D Of Doppler Global Velocimeter	1200
NIR-247	Laser Generated Ultrasonics For Nondestructive Evaluation	1230B
NIR-252	Flow Measurement in Subsonic Sonic Basic Research Tunnel	1212C
NIR-254	Error Analysis And Doppler Global Velocimeter Studies	1247D
NIR-257	Measurements Of Wake Vortices In The Terminal Area Of Various Airports	1202
NIR-258	Determine Various Laser Velocimeter Setups In Support Of Fmcb Requirements	1247D
NIR-265	Flow Characteristics Studies Using Raman And Rayleigh Measurement Techniques	1200
NIR-266	Development of Doppler Global Velocimeter and Blade Position Mead	1212
NIR-270	Argon-Ion Laser For Flow Visualization Of Synthetic Jet Experiments	1247D
NIR-272	Coherent Anti-Stokes Raman Scattering (CARS) Measurements In A Supersonic Combuster	1221C
NIR-274	Dev. of Non-Contacting Optical Measurement Techniques, Structural Deformation Measure	1200
NIR-276	Cloud geometry monitoring utilizing eye safe laser	Off site
NIR-277	R&D of optical non-destructive evaluation techniques for advanced material/systems	1230B
NIR-278	Laser velocimeter studies in the 20x28 ft. tunnel	1247D
NIR-279	Flow characteristics studies using an argon-ion laser for flow visualization of jet	1247D
NIR-280	Semiconductor lasers and fiber lasers research for Lidar and Atmospheric sciences	1299
NIR-284	Development of references for interferometric sampling and scan mirror velocity	1202
NIR-285	Measurements of Clouds and Atmospheric Aerosols, lidar laser system	1202
NIR-287	Particle Image Velocimetry and laser flow visualization air frame flow studies	1208
NIR-288	Diode Laser Research	1200
NIR-289	Laser Velocimetry Studies Centerwide	1230B
NIR-290	Measurement of Wind, CO2, H2O vapor utilizing laser systems	1202
NIR-291	Development of thermal dissipators for high power laser diodes	1148
NIR-293	PIV Experiments	1247D
NIR-294	Low Pressure Rf Induction Plasma	1148
NIR-295	Flight Measurements	1244 airborne
NIR-296	Laser Measurement Testing	1230

Source: NASA LaRC, RSO, 2001

10.2.3 Radioactive Materials

Radioactive materials not listed in Table 10-1 are stored in the Radioactive Material Storage Facility, Building 1254. Occasionally, excess materials from individual facilities are placed in Building 1254 for future use in research and development. The Radiation Safety Officer maintains the inventory of radioactive materials. The storage facility is located outside the 100-year floodplain. Even during a catastrophic hurricane event, any flooding of the facility would not be expected to expose LaRC or the environment to significant radiation from Building 1254. The storage facility is located well outside the blast safety zone that may be seriously affected by accidental explosions in the LAFB ordinance storage area located adjacent to NASA property.

NASA LaRC coordinates its space and atmospheric laser research activities with the FAA and LAFB to ensure the safety of aircraft flying in the area during such activities.

No significant potential for radioactive emission from the facility exists.

10.3 MAJOR ENVIRONMENTAL CONSIDERATIONS FOR PROPOSED ACTIONS

The following are considerations for new ionizing and non-ionizing radiation sources that may be required for proposed projects.

- Will any new action result in the need for any new source of ionizing radiation to be used on site?

- Will any new action result in the need for any new source of non-ionizing radiation to be used on site?

Positive response to either of these two questions should prompt immediate contact with the Center's RSO to ensure that no action jeopardizes compliance with NEPA, NRC, or State regulations. Additionally, contact should be made with the RSO if assistance is required to make any of these determinations. All construction and testing operations must be coordinated through the LaRC RSO so that environmental impacts can be properly assessed.

11. 0 UNDERGROUND AND ABOVEGROUND STORAGE TANKS

11. 1 REGULATORY OVERVIEW

11.1.1 Federal

The EPA regulations for Underground Storage Tanks (USTs) require that the new tanks and tanks already in the ground meet stringent performance standards, including corrosion protection, proper installation, overflow protection, and leak detection. The UST regulations can be found at 40 CFR Part 280. Table 11-1 summarizes the UST design requirements and associated schedules imposed by Federal regulations. The EPA also mandates regulations on oil pollution prevention (40 CFR 112) that are applicable to facilities with both USTs and Aboveground Storage Tanks (ASTs) which, due to their location, could discharge oil into navigable waterways. All Federal installations are responsible for complying with these regulations.

The Federal Oil Pollution Prevention regulations require preparation and implementation of Spill Prevention Control and Countermeasure (SPCC) plans. Under the guidelines for preparation of a SPCC plan, the regulations present minimum requirements for spill prevention, including appropriate containment and diversionary equipment for the protection of navigable waters (40 CFR 112).

11.1.2 State

The EPA granted approval of Virginia's Underground Storage Tank Program in October of 1998. The Virginia Department of Environmental Quality (VADEQ) is the implementing agency for UST activities in the State. Virginia's requirements that exceed the stringency of the Federal regulations include the following:

(1) Virginia's regulations do not allow for the installation of an UST system without corrosion protection under any circumstances, whereas EPA allows the installation of an UST system without corrosion protection if a corrosion expert determines that the site is not corrosive enough to cause the system to have a release due to corrosion during its operating life;
(2) Virginia's regulations require that owners and operators obtain a permit, undergo a State inspection, and/or obtain a certificate of use in accordance with the Virginia Uniform Statewide Building Code for the following circumstances: tank installation, tank repairs and release detection, and temporary closure, permanent tank closure, and changes-in-service. EPA's technical standards do not require permits or inspections of this nature, nor do they require conformance with State building codes;
(3) The Federal requirements at 40 CFR 280.20(e) allow six options for an owner or operator to demonstrate compliance with the installation requirements of section 280.20(d). The State's regulations do not allow two of these options: certification by the installer or inspection and approval of the installation by the implementing agency;
(4) Virginia's regulations require that UST systems with impressed current corrosion

protection systems must be installed so that they cannot be inadvertently shut off. EPA technical standards only require that the cathodic protection systems continuously provide corrosion protection;

(5) Virginia's regulations set forth the requirement that owners or operators file an application for and obtain a Corrective Action Permit (CAP) when corrective action is needed. The EPA's technical standards do not include such a requirement;

(6) Virginia's requirements for assessing the site at closure or change-in-service mirror the federal requirements with additional requirements for the testing of samples and submittal of test results, a description of the area sampled, and a site map;

(7) Virginia's state fund has been created to assist owners and operators in demonstrating financial responsibility; and

(8) Virginia's definition of ``regulated substance'' is more inclusive and therefore, broader in scope than the Federal definition.

In accordance with Virginia UST regulations (9VAC25-440-250), municipalities are responsible for issuing permits to temporarily or permanently close a regulated UST. The City of Hampton has the authority to issue such permits to LaRC.

Aboveground Storage Tanks (ASTs) are regulated in Virginia under provisions of the Virginia Oil Discharge and Administrative Regulations (9VAC25-90-10). The State regulations provide guidance for the development of facility and tank vessel contingency plans. The plans must include steps to respond to the threat of oil discharge, and to contain, clean up and mitigate an oil discharge within the shortest feasible time.

11.2 NASA LANGLEY OPERATIONS

NASA LaRC has bulk tanks for storage of gasoline, heating oil, and diesel fuel. Table 11-2 lists all active ASTs and Table 11-3 lists all active USTs at NASA LaRC. All leaks or releases are reported to appropriate State and/or Federal agencies by the Environmental Management Office (EMO). The Center’s SPCC Plan was integrated with the Hazardous Materials Spill Plan to form the LaRC Integrated Spill Contingency Plan. The Plan is maintained by the EMO.

As a result of past site characterizations and engineering investigations, LaRC has completed removal and/or replacement of its old UST and AST systems. In accordance with Virginia UST regulations, corrective actions were completed, where required.

11.2.1 Monitoring of Tank Systems

All regulated underground storage tanks are equipped with electronic leak-detection systems. Aboveground storage tanks are inspected on a routine basis.

TABLE 11-1
NASA LARC ABOVEGROUND STORAGE TANKS
May 2001

Building	Type of Material Stored	Capacity (Gallons)	Construction Material	Year Installed	Status
648	Diesel Fuel	2,000	Steel enclosed in concrete	1997	Active/Convault Design
1166 (90-day storage facility)	Waste oil	5,000	Steel	1991	Active/Adequately bermed
1233	Insulation Oil	8,000	Steel enclosed in concrete	1998	Active/ Gravel Surrounded
1244A	Diesel Fuel	1,000	Steel enclosed in concrete	1999	Active/Convault Design
1258	Insulation Oil	1,000	Steel enclosed in concrete	1999	Active/Convault Design
1260	Insulation Oil	1,000	Steel enclosed in concrete	1999	Active/Convault Design
1297C	No.2 Fuel Oil	1,000	Steel enclosed in concrete	1999	Active/Convault Design

TABLE 11-2
NASA LARC UNDERGROUND STORAGE TANKS
May 2001

Building	Type of Material Stored	Capacity (Gallons)	Constr. Material	Year Installed	Status/Plan
1199	Gasoline	8,000	F	1992	All are active
1199	Gasoline	8,000	F	1992	
1199	Diesel Fuel	6,000	F	1992	
1215	No.2 Fuel Oil	50,000	C	1968	Field constructed, Inactive
1215	No.2 Fuel Oil	50,000	C	1968	Field constructed, Inactive
1215	No.2 Fuel Oil	50,000	S/F	1993	Active
1215	No.2 Fuel Oil	50,000	S/F	1993	Active
1215	No.2 Fuel Oil	50,000	S/F	1993	Active

C – concrete, S – Steel, F - Fiberglass

11.3 MAJOR ENVIRONMENTAL CONSIDERATIONS FOR PROPOSED ACTION

Plans for the installation of any new storage tank or for the re-activation of an existing unused storage tank must be coordinated through the EMO to determine whether the proposed tank system designs meet all existing storage tank regulations. Also, any tank taken out of service or emptied and not scheduled for daily use must be evaluated for closure. The UST regulations have requirements for tank closure. All construction and testing operations must be coordinated through the EMO so that environmental impacts can be properly assessed.

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12.0 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

12.1 REGULATORY OVERVIEW

Federal law, including the National Historic Preservation Act (NHPA), requires NASA to initiate measures and procedures to ensure the protection and proper management of cultural resources, including historic and prehistoric properties. In order to incorporate these measures into existing plans and programs, NHPA and related Federal legislation require agency consultation with the Virginia Department of Historic Resources, State Historic Preservation Office (DHR-SHPO), and the Advisory Council on Historic Preservation (ACHP). The Federal and State preservation laws and regulations can be found at the following two websites: http://www.cr.nps.gov/linklaws.htm and http://www.dhr.state.va.us.

The NASA policies include:

- NASA Procedures for Implementing the National Environmental Policy Act (14 CFR 1216.300)
- Historical and Artifacts Program (LAPD 1070.1)
- NASA Environmental Management (NPD 8800.16)
- NASA Records Management (NPD 1440.6E)
- Identification and Disposition of NASA Artifacts (NPG 4310.1)

12.1.1 Consultation Process

Section 106 of NHPA requires all Federal agencies including NASA to consider the effects of their actions on historic properties and to give the ACHP an opportunity to comment on such actions. The ACHP's regulations, Protection of Historic Properties (36 CFR 800), implement the Section 106 process and emphasize consultation between the responsible Federal agency, the DHR-SHPO, and other interested parties, including representatives of Native American groups.

The revised Section 106, effective June 17, 1999, is the formal regulatory review process required to assess the impact of the proposed changes on affected federal agencies. Following the steps listed below prior to proceeding with any undertaking ensures compliance with NHPA's Section 106 by NASA (also refer to Section 12.3):

a. Identify historic properties that exist in the area to be affected and consult with the Virginia DHR-SHPO to determine the need for further actions.

b. Evaluate the effect of the proposed action on historic properties identified and consult with the Virginia DHR-SHPO.

c. Document findings and make the documentation available for public inspection. (Archeological site location information is kept confidential from public view and distribution to ensure that no damage occurs to these resources).

d. Consult the Virginia DHR-SHPO for a determination of effect and to determine if further Section 106 efforts are necessary.

e. Consult with the Virginia DHR-SHPO, other interested parties, and the ACHP to seek agreement on ways to avoid or reduce the effects, if a proposed action is expected to have an adverse effect (Criteria of Effect and Adverse Effect, 36 CFR 800.9). If an agreement is reached, a Memorandum of Agreement (MOA) is drafted and signed.

f. Request formal comments from the ACHP if a MOA is unattainable. Effects may be mitigated through a data recovery program that can result in a no adverse effect determination. Acceptance of a MOA implies compliance with the requirement that the ACHP be given opportunity to comment.

g. Carry out the terms of the MOA or consider the formal ACHP comments in making final decisions about proceeding with the proposed action.

Section 110 of the NHPA requires that all Federal agencies inventory cultural resources under their jurisdiction that meet the criteria for listing on the National Register of Historic Places (NRHP). Section 110(f) of the NHPA requires that before approving a Federal undertaking, that may directly and adversely affect a National Historic Landmark (NHL), the head of the responsible Federal agency shall, to the maximum extent possible, undertake such planning and actions to minimize harm to a landmark.

12.2 NASA LANGLEY OPERATIONS

12.2.1 Cultural Resources Studies and Existing Resources

Various cultural resource studies have been conducted at NASA LaRC and at the Langley Air Force Base (LAFB). "A Short History of Historical Properties Now Included in the West Area of Langley Research Center, NASA," describes the historic settlement of the area (NASA LaRC Historical and Archeological Society, 1974). In 1990, a cultural investigation was conducted at the Syms School archeological site (portion of LAFB); it was recommended that the site be nominated to the NRHP. A portion of this site is located on the NASA LaRC property and should be assessed for NRHP eligibility. In 1992, MAAR Associates, Inc. conducted a cultural resource survey for a proposed industrial complex site at NASA LaRC and identified one multi-component (historic-prehistoric) site (MAAR Associates, Inc. 1992). In 1995, Gray & Pape Inc. conducted archaeological investigations in the western portion of the Center and along Chesterville Road and King's Highway.

A portion of NASA LaRC has been inventoried for buildings that may be considered to be historically significant; inventory of the remainder of the Center is on-going. Archeological surveys have been performed at various locations throughout NASA LaRC, and a Center-wide Phase I and predictive analysis of potential archeological resources is essentially complete under a contract with the ACOE. At present, five NHLs have been identified at NASA LaRC and are listed on the NRHP (NASA LaRC, 1992). These include the Variable Density Wind Tunnel constructed in 1922 (moved from its original site in the East Area and now exhibited for visitors in the West Area); the Full-Scale Tunnel constructed in 1930 (deactivated); the Eight-Foot High-Speed tunnel constructed in 1936 (defunct and used as office space); the Lunar Landing Research Facility constructed in 1965 (operational in crash research); and the Rendezvous Docking Simulator constructed in 1963 (substantially dismantled).

12.2.2 Consultation Process

NASA LaRC has a Programmatic Agreement (signed September 20, 1989) among the National Conference of State Historic Preservation Officers (NCSHPO), and the ACHP which addresses agency consultation and mitigation on projects which through demolition, alteration, or new construction affect facilities designated as NHLs.

In accordance with the Programmatic Memorandum of Agreement (PMOA), the following procedures are mandated when proposed undertakings affect NHLs:

- If the undertaking involves demolition, dismantling or relocation of original engineering structures, or of buildings, housing facilities, or removal or excessing of significant elements of the landmarks specifically named in the National Register nomination forms, or new construction not compatible with major portions of the original structure, or changes in function, purpose or use of a facility, NASA will consult with the DHR-SHPO (details of this consultation are presented in the PMOA) and, as necessary (in the event of disagreement between NASA and the DHR-SHPO), with the ACHP.

- If historic hardware or components are replaced, structures are modified, or compatible construction is undertaken, so that the NHL-designated characteristics of the facility are not altered, NASA will develop and implement mitigation measures (recordation or salvage).

- If none of the specified activities are involved in the undertaking, NASA may proceed without consultation or mitigation.

- Consideration should be given to developing a PMOA with the Virginia DHR and the Advisory Council which would serve as the basis for Section 106 compliance for all on-going and future activities not affecting the NHLs. NASA LaRC has a designated Facility Preservation Officer who will pursue development of such a PMOA. Until such time as a PMOA is in place, projects and activities at NASA LaRC will require individual compliance with Section 106. Nevertheless, NASA

LaRC has successfully adapted procedures similar to the PMOA for NHLs to comply with NEPA requirements for other on-going activities.

The National Park Service (NPS) has completed an architectural survey of the East Area of LaRC in concert with LAFB. The survey assessed the NRHP eligibility of structures in this area. A nomination for the Langley Field Historic District is being submitted to the Keeper of the National Register. The report prepared on the survey supplements the existing architectural survey of LAFB completed by the NPS in 1992 (NPS, 1992).

In 1995, Gray & Pape Inc. developed a Cultural Resources Management Plan (CRMP) for NASA LaRC under the direction of the Facility Preservation Officer. This Plan is based upon information obtained from the previous archeological surveys and buildings inventories within NASA LaRC as well as from the Centerwide archeological surveys and building inventories. The Plan specifies zones of cultural resources potential and provides guidelines that will facilitate the historic preservation process within NASA LaRC. The draft CRMP was evaluated by contract historic preservation specialists working on behalf of NASA HQs. NASA HQs is in the process of developing an Agency-wide CRMP policy for guidance.

12.2.2 Cultural and Recreational Facilities

The Center has four tennis courts, an indoor and outdoor basketball court, three softball diamonds, and the H.J.E. Reid Conference Center located at 14 Ames Road. The Langley Activities Association and Conference Center provide numerous social options for NASA families, including club meeting facilities, food service, and organized leagues for bowling, golf, softball, football, and tennis. The area's moderate climate enables families to enjoy a picnic area and playground located just outside the Conference Center.

Langley Air Force Base provides additional recreational activities, available on a limited basis to NASA personnel. These activities include horseback riding, bowling, golf, and use of the Hobby Shop, Yacht Club, Non-Commissioned Officers' (NCO) Club, and Officers' Club.

Cultural and large-scale recreational facilities are not provided on the Center since these additional activities are plentiful on the Virginia Peninsula. Various parks, playgrounds, gymnasiums, theaters, and museums provide LaRC personnel with abundant off-base facilities for entertainment and recreation. Area parks and recreation departments provide year-round programs and festivals. Residents can enjoy a wide range of cultural programs, including the Virginia Choral Society, the Virginia Symphony Orchestra, community theaters, and community concert series. Hampton Coliseum provides a varied program of sporting events, craft and antique shows, musical concerts, and other special events.

The area also has many historical and contemporary points of interest. Among these are Langley Air Force Base, Headquarters of the Air Combat Command; Fort Monroe, Headquarters of the Training and Doctrine Command; Fort Eustis, Headquarters of the

U.S. Army Transportation Center; Saint John's Church; Fort Monroe's Casemate Museum; Fort Eustis' Transportation Museum; Mariner's Museum; Virginia Living Museum; Peninsula Fine Arts Center; War Memorial Museum; Air Power Park; Hampton Carousel; and Harbor Cruises.

In a cooperative effort, the NASA Langley Visitor Center has become part of a dynamic new cultural-educational center on Hampton's downtown waterfront which includes the Virginia Air and Space Center, Hampton Roads History Center, and a 300-seat IMAX theater, opened on April 5, 1992. The Virginia Air and Space Center focuses on various themes and integrates exhibits, space artifacts, and various aircraft suspended overhead of the main gallery. The Center's public programs provide an introduction to aeronautics and space.

12.3 MAJOR ENVIRONMENTAL CONSIDERATIONS FOR PROPOSED ACTIONS

Before any new construction project or earth movement occurs, the impacts to historic, archeological and cultural properties must be assessed through formal consultation with the Facilities Program Development Office and the EMO to ensure proper documentation in Environmental Assessments and Impact Statements. As mandated by Federal law, the review process should include all present and future construction activities, including construction projects, earth movement, road construction landscaping, renovation of existing structures, demolition of existing structures, etc.

Where appropriate, field investigations should be conducted to assess potential impacts to historical properties.

The existing PMOA should be followed when any action is considered concerning the five properties designated as NHLs.

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13.0 COMMUNITY RELATIONS AND LOCAL ECONOMY

13.1 REGULATORY OVERVIEW

Existing environmental laws, including the NEPA, CAA, CWA, RCRA, CERCLA, TSCA, and FIFRA, mandate environmental objectives, requirements and procedures for Federal agency operations. To assist with compliance with these laws, NASA LaRC has developed and implemented an environmental compliance, restoration, and pollution prevention program to study, refine, improve, and revise construction and operation practices which compromise human health and the environment. LaRC has also developed an Emergency Plan (LAPG 1046.1, January 2000) which coordinates with local governments, police, and fire departments to respond to any emergency situations arising from its operations.

Executive Order 12898 dated February 11, 1994 requires that each Federal agency make achieving environmental justice part of its mission. This involves identifying and addressing the adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions. NASA Headquarters published the agency environmental justice strategy in March 1995. Individual centers, including NASA LaRC, published their environmental justice implementation plans in March 1996.

13.2 NASA LANGLEY OPERATIONS

Technological advances at NASA LaRC over the years have resulted in an increase in the use of hazardous chemicals and inadvertent small-scale releases of a number of these chemicals to the environment through air emissions and spill/leakage/discharge on land and to water bodies. Prior to the passage of NEPA in 1969, RCRA in 1976, and CERCLA in the early 1980s, nationwide industrial and Federal agency releases of hazardous substances were common and the landfilling of chemical waste occurred.

Tabbs Creek, a tidal estuary with origins on NASA property, has been studied to determine the degree of PCB/PCT contamination and to evaluate possible threats to human health and the environment. Site investigations performed have identified the presence of PCBs, PCTs, pesticides, dioxins, furans and metals in fish and shellfish of Tabbs Creek. The State has banned shellfish harvesting in Tabbs Creek since 1980 due to bacterial contamination (Condemned Shellfish Area Number 21, Back River, 28 June 1999). A Public Health Assessment completed by the U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry (ATSDR, 1998) concluded that on the basis of available data, the past occasional ingestion of fish and shellfish from Tabbs Creek is unlikely to pose a health hazard for either adults or children. NASA LaRC has eliminated potential sources of contamination, and a clean-up of the sediments in Tabbs Creek was completed in the spring of 2000.

NASA LaRC has developed a comprehensive community relations program under the Center's Superfund program. Since 1993, NASA LaRC has conducted a number of outreach activities designed to inform the public about cleanup of contaminated areas at the Center and create avenues for citizen input into the decision-making process.

NASA LaRC's Superfund program and related outreach activities are described in the NASA LaRC Community Relations Plan. In addition, NASA LaRC has developed an Environmental Justice Implementation Plan. Both plans outline the Center's community outreach strategies, which help to ensure that outreach efforts continue to target groups that constitute a representative cross-section of the local population.

13.2.1 LaRC Community Relations

The cities of Hampton and Poquoson, Virginia, and York County, Virginia are directly adjacent to the NASA LaRC perimeter. The City of Poquoson is located to the north and is primarily a residential community. The City of Poquoson covers 16 square miles and includes 4,398 acres of salt marsh wetlands and 84 miles of shoreline (City of Poquoson, 2001). Poquoson is populated primarily by upper-middle class, white families with a median family income of $64,716. The City has a low poverty rate of 4.1 percent and a minority population of 3 percent (Hampton Roads Planning District Commission (HRPDC), 2001).

Residential areas of York County (106 square miles) lie to the northwest of NASA LaRC. Residents of York County are primarily middle class, with a median family income of $57,153. The County's poverty rate is at 5.5 percent and the population is approximately 79 percent white, 18 percent Africa-American, and 2 percent Asian, Native American, and other minorities (HRPDC, 2001).

The City of Hampton (52 square miles), with a large residential community, lies to the south and southwest of NASA LaRC. Although the city is about half the geographical size of York County, Hampton's population is three times larger than that of York County. The median family income is $43,527 and the poverty rate is at 14.2 percent. Hampton's population is 54 percent white, 43 percent Africa-American, and 3 percent Asian, Native American, and other minorities (HRPDC, 2001).

The area to the west of NASA LaRC is one of the least developed areas of the City of Hampton. Development immediately outside the western/southwestern NASA LaRC boundary consists of two residential trailer parks (Langley Village and Sulik Mobile Home Court), an apartment complex (Spinnaker Cove) and an auto race track (Langley Raceway). There also are a number of small commercial businesses, fast food restaurants, a hotel, and a few single-family homes along the NASA LaRC western border. The buildings within a 2-mile radius are primarily residential and commercial, although office buildings are located in the Hampton Roads Center and some laboratories are found in the Langley Research and Development Park located nearby. A childcare facility exists on the NASA LaRC grounds that provides day care for children of NASA employees.

13.2.2 Local Population Factors

The economic study area addressed in this ERD is within a one-hour commuting radius (50 miles or 80 kilometers) from NASA LaRC. The area includes the portions of the Norfolk-Virginia Beach-Newport News, VA-NC Metropolitan Statistical Area (MSA) known as Hampton Roads. The area includes the cities of Hampton, Poquoson,

Newport News, and Williamsburg; and James City County and York County in Virginia. NASA LaRC is located in northern portion of the City of Hampton.

13.2.2.1 Population

According to the U.S. Bureau of the Census, the City of Hampton population was 133,773 in the most recent Census (1990). The total population of the Hampton Roads MSA for 1990 was 1,396,107. Table 13-1 lists the 1980 and 1990 Census populations for each area of the Peninsula and the Hampton Roads Planning District Commission's Population Estimates for 2000. As the table shows, the Peninsula area experienced significant growth over the 10-year period from 1980 to 1990. The population growth estimates from 1990 to 2000 also indicate continued growth in the area.

Table 13-1
1980 and 1990 U.S. Census Populations and 2000 Population Estimates

Year	Hampton	Newport News	York County	James City County	Williamsburg	Poquoson
1980	122,617	144,903	35,463	22,339	10,294	8,726
1990	133,773	171,477	42,434	34,779	11,600	11,005
2000	146,437	180,150	56,297	48,102	11,998	11,566

Source: HRPDC, 2001

13.2.2.2 Employment

Total employment for the MSA in 1997 was 920,119. Government had the highest percent occupation level in the MSA in 1997 (27.7 percent) followed by services at 27.6 percent and retail trade at 19.8 percent. Military employment accounts for 12.3 percent of the total employment (HRPDC. 2000). Table 13-2 lists the occupational profile for the MSA.

NASA LaRC has a local payroll of $188.2 million and employs approximately 2,241 civil service employees, primarily engineers and technicians, and 1,576 contractors. NASA LaRC contracts annually for about $606 million in goods and services both locally and nationally (NASA Langley Economic Impact FY 1998). Thus, NASA LaRC forms an important part of the economy of the City of Hampton and the MSA.

Table 13-2 MSA Employment for 1997		
Occupation	Annual Average Employment	Percentage
Farm/Agricultural/Forestry/Fishing	9,712	1.1
Transportation/Public Utilities	36,345	4.0
Finance/Insurance/Real Estate	55,021	6.0
Construction and Mining	56,165	6.1
Manufacturing	71,006	7.7
Retail and Wholesale Trade	182,265	19.8
Services	254,292	27.6
Government, Total	255,313	27.7
Federal, Civilian	47,639	5.2
Military	112,795	12.3
State and Local	94,879	10.3
Total Employment	920,119	
Source: HRPDC, 2000		

13.2.2.3 Income

In 1997, the per capita income of the MSA was $21,983 which was approximately 87 percent of the average U.S. per capita income. The Peninsula per capita income varies, from $21,646 in the City of Hampton to $25,030 in the city of Poquoson and York County (HRPDC, 2001). According to the 1990 U.S. Census, the number of families below the poverty level income in the MSA was 9 percent in 1990 compared to 10.8 percent in the City of Hampton. The City of Poquoson and York County, which are relative affluent, had fewer than 5 percent of their families with income below poverty level.

13.2.2.4 Housing

The 1990 U.S. Census data indicate that the total number of occupied housing units in the MSA was 493,536 in 1990. A majority of the units (302,559) were single-family units. Total inhabited units numbered 49,673 in the City of Hampton, 3,769 in the city of Poquoson and 14,474 in York County. The vacancy rate is about 8 percent whereas in Poquoson and York County the vacancy rate is lower at 5 and 3 percent, respectively. In the period 1980 to 1990, all three local jurisdictions have seen significant growth in housing construction. Housing growth in the Hampton Roads area is shown in Table 13-3 and is based on 1990 U.S. Census data.

Table 13-3
Housing Growth in Hampton Roads, 1980 - 1990

Location	Housing Units		Change (1980 - 1990)	
	1980	1990	Number	Percent
James City County	8,524	14,330	5,806	68.1
Newport News	54,986	69,728	14,742	26.8
Poquoson	2,943	3,890	947	32.3
Hampton	43,652	53,623	9,971	22.8
Williamsburg	3,041	3,960	919	30.2
York County	11,401	15,284	3,883	34.1
Peninsula Totals	124,547	160,815	36,268	29.1
Source: U.S.Census, 1990				

13.2.3 Security and Law Enforcement

The City of Hampton police force employs 245 sworn police officers, 40 telecommunications personnel, 13 school crossing guards and police aides, 10 sworn auxiliary police officers, 4 police cadets, and 51 civilian support personnel (Hampton Police Division, 2000).

Access to NASA LaRC is controlled on a 24-hour, year-round schedule at access gates by uniformed security support contractor officers. Security officer responsibilities consist of on-foot and motorized patrols.

13.2.4Fire Protection

The Hampton Division of Fire and Rescue provides fire and rescue emergency services for the City of Hampton and is comprised of nearly 500 career and volunteer firefighters, medics, and civilian personnel. The Division maintains 10 fire stations, six of which have volunteer fire companies, and four of which have volunteer rescue squads. All volunteers receive training identical to that of career personnel. The Division is equipped with 17 pumper trucks, two telesquirts, two aerial ladder trucks, one heavy rescue vehicle, 16 ambulances, one dive truck, and one HAZMAT truck.

A cooperative agreement exists between NASA LaRC and the City of Hampton for reciprocal integrated fire protection service. NASA LaRC provides the firefighting facilities, located at Building 1248, as well as two fire engines, one ambulance, one light rescue vehicle, and one utility vehicle. One off-base engine and one on- and off-base ambulance are also housed at the fire station. The City of Hampton provides the personnel to staff the fire station and continuous surveillance of communication equipment to receive alarms, transfer calls, and to maintain fire station communications. The station provides fire and EMS protection for NASA LaRC and residential and commercial properties in the north end of the City of Hampton. It also provides mutual aid for neighboring Poquoson and Langley Air Force Base. The station is staffed with 21 personnel covering three shifts 24-hours a day. The Hampton Division of Fire and Rescue staffing for each shift is one Captain or Lieutenant, two Medics and three

Firefighters. NASA LaRC provides its own Administrative Fire Chief (LAPG 1046.1 NASA LaRC Emergency Plan, January 2000).

13.2.5 Schools

The City of Hampton public school system includes 36 schools with a total enrollment of approximately 23,000 students in elementary, middle school, and high school. The Poquoson school district has 4 public schools with a total enrollment of approximately 2,400 students. The following table shows enrollment and pupil/teacher ratios for area schools.

Table 13-4
Area Schools Enrollment and Pupil/Teacher Ratios

School District	Number of Schools	1998-1999 Enrollment	Ratio of Pupils to Classroom Teaching Positions (1997-98)	
			Grades K-7	Grades 8-12
Hampton	36	23,121	12.6:1	16.0:1
Poquoson	4	2,429	16.3:1	14.4:1
York	19	11,276	15.9:1	13.8:1
Newport News	46	31,149	15.0:1	13.3:1
Source: Virginia Department of Education, 2000				

Higher education programs serving the area include the following:

- Old Dominion University (satellite campus in Hampton)
- Hampton University and Thomas Nelson Community College in Hampton
- College of William and Mary in Williamsburg
- Virginia Institute of Marine Science at Gloucester Point
- Old Dominion University, Norfolk State University, and Virginia Wesleyan College in Norfolk
- Christopher Newport University in Newport News
- Other institutions serving Hampton Roads: George Washington University Hampton Roads Center, Regent University, Eastern Virginia Medical School, Rappahannock Community College, and Tidewater Community College

Industrial, technical, and trade schools in the area include Langley Research Center Technical Program, Virginia Department of Economic Development Work Force Training Service, New Horizons Technical Center and the Newport News Shipbuilding Apprentice Program. These are fully accredited vocational-technical schools. NASA LaRC provides a range of support to educational institutions from primary school programs to post-doctoral research opportunities.

13.2.6 Health Care Facilities

The City of Hampton has full-service acute health care services available through Sentara Hampton General Hospital, the Veteran Affairs Medical Center, and the 1st Medical Group (Langley Air Force Base). The Peninsula area has four general hospitals, two specialty hospitals, and three military hospitals totaling 1,865 bed spaces (Hampton Roads Newcomer, 1999).

The NASA LaRC occupational medicine program incorporates both an onsite health clinic and an employee fitness center. These facilities are contractor operated. The highly trained staff includes a part-time physician, two registered nurses, one nurse practitioner, one medical technologist/x-ray technician, one medical assistant part-time, two physical fitness coordinators, and two administrative employees. Supporting ophthalmology, optician, and medical laboratory services augment the clinic's operation. Services provided by the health clinic include: emergency diagnosis and treatment of accidents and injuries, physical examinations, administration of treatment and medication, a health education program, mammography services, Bloodmobile support, and foreign travel information and immunizations. The Fitness Center offers personalized fitness and conditioning programs, including aerobics classes. An offsite Employee Assistance Program (EAP) is also provided. (NASA LaRC Office of Human Resources, 2000).

13.2.7 Utilities

13.2.7.1 Electrical Power

Electrical power is supplied throughout the Peninsula by Virginia Power, and NASA LaRC is one of the largest single customers connected to its system. The Center is served from Virginia Power's Peninsula Substation by two 115 kV overhead lines. Each line is protected by a circuit breaker at Virginia Power's Peninsula Substation. The present transmission system at NASA LaRC consists of cables and overhead lines operating at voltages from 115 kV down to 2.3 kV.

The usage of power is maintained within the following contracted agreements:

- During "on-peak" hours, 7:00 a.m. to 10:00 p.m., Monday through Friday, the normal maximum load is 40 megawatt (MW) firm on peak plus an additional 110 MW excess (interruptible in peak). If required, excess power up to 205 MW can be approved by Virginia Power.
- All other hours (off-peak), the power is limited to 245 MW.
- Non-emergency rate of change of power in excess of 100 MW per minute has special contracted limitations.

Under the present arrangement, NASA LaRC supplies power to the LAFB facilities located on the base, the Navy Tow Tank (Building 720), and to the Big Bethel pumping station under interagency agreements. Additionally, LaRC supplies electrical power to

the Full Scale Tunnel currently leased to Old Dominion University under a Memorandum of Agreement.

13.2.7.2 Water Supply

NASA LaRC does not operate a public water system. The source of NASA LaRC West Area's potable water is the Chickahominy River and the Diascund and Little Creek Reservoirs. Raw water from these sources is pumped approximately 30 miles to the City of Newport News' treatment plants located at the Lee Hall and the Harwood's Mill reservoirs. These two plants combined can treat 85 million gallons of water per day. The source of NASA LaRC East Area's tap water is the Bethel Manor Reservoir. Water from this reservoir is treated by the Big Bethel Water Treatment Plant which is owned by the U.S. Army, Fort Monroe. The East Area is served by the Langley Air Force Base water system which purchases its water from Fort Monroe.

NASA LaRC West Area water consumption for FY 1999 was 178.8 million gallons. Large consumers include cooling towers and steam production from the West Area Heating Plant (Building 1215) and the Refuse-Fired Steam Generating Facility (Building 1288). These large users accounted for approximately 37 percent of total water usage for FY 1999.

The West Area of NASA LaRC is connected to the City of Newport News water distribution system via an 8" meter and 8" service line located at Armistead Avenue directly behind Building 1146. The NASA LaRC main service line then connects to a double check valve located in Building 1146E before continuing to dual booster pumps located at Building 1215. The booster pumps elevate the system pressure to 80 psi to insure adequate pressure for fire protection. From the booster pumps, water is distributed to the Center via a 10" main with 10" to 3/4" service lines, and to the 500,000 gallon elevated storage tank. A 400,000 gallon reserve is maintained in the elevated storage tank.

Back-up water supply for the West Area is provided by a metered connection to the Langley Air Force Base water system. The back-up water supply connection is via a 14" water main from Langley Air Force Base that ties into the NASA LaRC 10" main at the base of the elevated storage tank. The connection consists of two valves and a hydrant that allow the connection to be flushed prior to opening.

NASA LaRC also provides water to the LAFB Munitions Area. This connection consists of a loop tied into the 8" service line at Building 1275 and at the base of the elevated storage tank. The service line is metered at both connections.

13.2.7.3 Sanitary Sewer System

Sanitary sewage disposal is provided by the Hampton Roads Sanitation District (HRSD). Wastewater discharges from NASA LaRC to the sanitary sewer system are regulated under a permit issued by HRSD. NASA LaRC has an 8" PVC force main which is connected to the HRSD system. A gravity-fed grinder pump and the sewer

effluent meter are located at Building 1223. The force main exits near the Wythe Creek Road side of Building 1212 and connects to the HRSD system.

13.2.7.4 Stormwater System

NASA LaRC has a network of man-made stormwater conveyances including separate storm sewers, ditches, drainage channels, and pipes which discharge into surface water bodies adjacent to the Center. Thirteen outfalls located in the West and East areas of NASA LaRC are permitted by the Virginia Department of Environmental Quality under a Virginia Pollutant Discharge Elimination System (VPDES) Permit. The major discharges from the Center outfalls are stormwater, cooling tower blowdown and boiler blowdown water. Other discharges include municipal water releases from the Landing Loads Test Facility (Bldg. 1257), car wash discharges, and water discharges from the Tow-Tank Test Facility (Bldg. 720). NASA LaRC's Stormwater Pollution Prevention Plan Operation and Maintenance Manual (January 2000) contains detailed information on potential sources of storm sewer system pollution and the controls used to eliminate or minimize the risk of contaminated discharges.

13.2.7.5 Central Heating/Steam System

NASA LaRC's West Area has a network of steam lines laid in underground tunnels or subsurface trenches that provide steam for both institutional and research demands. The LaRC West Area total steam demand is provided by both the West Area Steam Plant (Building 1215) and the Refuse Fired Steam Generating Facility (RFSGF, Building 1288). Steam for research facilities is provided by the West Area Steam Plant, and institutional steam is provided by the RFSGF. Based on the FY 1999 yearly average, approximately 78 percent of the NASA LaRC West Area steam demand is supplied by the RFSGF and 22 percent by the West Area Steam Plant.

The RFSGF is permitted to and operated by a Joint Board of Oversight representing the City of Hampton, NASA LaRC, and the Air Force. The City of Hampton maintains the facility and monitors emissions on a regular basis as required under the State permit. NASA LaRC's responsibility involves providing engineering support and active involvement with the Joint Board of Oversight. The Joint Board of Oversight monitors new regulations applicable to the RFSGF that are designed to meet CAA objectives and evaluates alternatives to achieve compliance.

13.2.7.6 Natural Gas

Natural gas is provided by Virginia Natural Gas. Gas is delivered to a regulating station in company mains and distributed within NASA LaRC by government installed lines. The NASA LaRC service line distribution pressure is approximately 25 pounds per square inch (Virginia Natural Gas, 2000).

13.2.7.7 Telecommunications

In 1989, the ROLM 9751 Computerized Branch Exchange (CBX), the integrated ROLM PhoneMail system, and a new underground cable distribution plant were installed at

LaRC. The current CBX system provides all standard telephone capabilities such as extension dialing, local calling and access to the Federal Telecommunications System long distance services (FTS) as well as additional features such as call transfer, forward, name display, Automated Call Distribution (ACD), PhoneMail voice messaging, and a low speed data network with dial-up modem access. The system also features an emergency announcement system. This feature allows callers to hear important messages about current NASA LaRC operations. Since 1989, there have been several hardware and software upgrades to the system. The CBX and PhoneMail systems are currently maintained at the highest software release available on the respective hardware platform. In the event of catastrophic failure, bypass telephones are automatically activated to provide a direct connection to the local carrier.

The NASA Langley Research Center Computer Network (LaRCNET) is the center-wide network that connects a majority of Langley's computing systems together. The network was initially installed in 1985 with the goal of providing local researchers with better access to Langley's Supercomputers. Since that time, it has grown from a network servicing 3 buildings and 20 computers, to its current configuration of three main FDDI rings servicing over 100 buildings and connecting 10,000+ devices.

The Backbone Ring is the primary FDDI ring of LaRCNET. The ring joins the 100+ buildings that make up LaRCNET and connects most of the 10,000+ devices on LaRCNET. All of the buildings that connect to the backbone have Ethernet segments run throughout the building with some buildings having as many as 12 Ethernet segments. TCP/IP is the main protocol run across the backbone although the ring also supports Appletalk, DECNET, and Novell. This network is presently being upgraded to support switched Ethernet/Fast Ethernet throughout.

The Direct Attached Ring connects NASA LaRC’s HPCC systems and high-end research computers as well as serving as the backbone for Langley's wind tunnels. The ring and all its hosts are currently connected via FDDI. However, the use of FDDI for individual computers will be phased out and replaced with Fast Ethernet. The ring currently joins 24 buildings/ networks with approximately 1000 host connections. TCP/IP is the only supported protocol on the Direct Attached Ring.

The Isolation LAN supports all of LaRC's external network connections. It is currently a FDDI network with connections to GTE, NISN Standard, NISN Premium, NREN, and some of LaRC's offsite contractors. TCP/IP and DECNET are the only protocols that are transported off of LaRCNET. The Isolation LAN also hosts the portion of LaRCNET where access by the public is required.

13.2.7.8 Transportation

Highways and Roads

The primary freeway through the city of Hampton is Interstate 64 (I-64) which connects with Interstate 664 and Interstate 264. The I-64/664/264 system provides quick access from Hampton to Newport News, Virginia Beach, Chesapeake, Suffolk and the Williamsburg area. Two bridge-tunnels, one on I-64 and the other on I-664, link

Hampton to the Southside of the Hampton Roads metropolitan area. I-64 continues west where it links with I-95, I-295, and I-81, which provides access to major east-west and north-south interstate systems.

Three U.S. highways serve Hampton Roads. U.S. Route 17 north connects with Fredericksburg, Virginia at I-95 and leads south along the coast through the Carolinas. U.S. Routes 258/58 reach west along the Virginia/North Carolina border with interchanges at I-95, I-85 and I-81. U.S. Route 60 leads north to Richmond and then through central Virginia. U.S. Route 13 connects Hampton Roads with the Eastern Shore of Virginia and Maryland. Approximately 50 motor carrier companies operate terminals in Hampton Roads for freight handling and load consolidation.

Mass transit bus service is provided by Hampton Roads Transit. Hampton Roads Transit buses operate seven days a week and provide service on a network of routes throughout Hampton, Newport News, Norfolk, Virginia Beach, Portsmouth, Chesapeake and Suffolk, as well as bus service between the Southside and the Peninsula. Transit buses are lift equipped for persons with disabilities, and curb-to-curb service for physically and mentally disabled individuals is available.

Traf*FIX* is the Hampton Roads regional rideshare agency that provides commuter consultation services including employer programs, commuter services, and rideshare alternatives. The Virginia Department of Transportation also maintains a number of “Park & Ride" commuter parking lots throughout the area to encourage ridesharing. Taxi services are provided by more than 20 taxicab companies located on the Peninsula.

Airports

Two major airports are within a 30-minute drive from the city of Hampton. The Newport News-Williamsburg International Airport is located in Newport News one mile north of I-64. The airport is serviced by three major airlines that provide nonstop or direct flights to four cities and 44 daily passenger flights. Facilities include an 8,000-foot nondirectional beam instrument approach runway that can handle any size jet, including the jumbo C-5A military transport, and an 115,000 square foot, ten-gate passenger terminal.

The Norfolk International Airport is located in Norfolk one mile east of I-64. Services include scheduled passenger and cargo airlines, general aviation, air taxi, and charter flights. The airport is serviced by 11 major airlines which provide nonstop or direct flights to 59 cities and 95 daily passenger flights (Newport News Economic Development Authority, 1997).

Railways

Two major railroads, Norfolk Southern and CSX Corporation, provide cargo services in the Hampton Roads area. Norfolk Southern operates two major rail systems with about 14,300 miles of track in 20 states and Ontario. CSX Corporation has an 18,500-mile

system encompassing 20 states, Washington, D.C., and Ontario. In 1999, Norfolk Southern and CSX Corporation bought
Conrail Inc. and will split the railroad's 11,000 miles of track (Hampton Roads Statistical Digest, *Virginia Business*, 1999).

Passenger rail service is provided by Amtrak from their passenger station located in Newport News. Amtrak provides daily service to Washington, D.C., Baltimore, Philadelphia, New York, and Boston (Amtrak, 2000).

Waterways

The Port of Hampton Roads is the world's deepest natural harbor and leads the nation in the volume of exports. In 1999, 11.8 million short tons of general cargo were shipped into and out of the Port. On the Peninsula, the Port includes the Newport News Marine Terminal (NNMT) equipped with four berths to handle container, breakbulk, and roll-on/roll-off cargos. Storage space includes 394,000 square feet of covered pier storage and 256,000 square feet of dry storage. The port also has container storage with a 1,210 chassis container capacity and 790 a stacked container capacity. The facility has 42,720 footage of direct rail access/rail track that includes on-pier trackage for direct cargo loading on and off ships to and from rail (Virginia Port Authority, 2000). The NNMT also has a 29,000 foot passenger cruise terminal. The passenger terminal is a fully dedicated cruise ship terminal capable of handling a wide variety of passenger vessels. Roadway access to the NNMT is via Interstate 64 and 664 and U.S. Route 17. Rail service is provided by CSX Corporation.

14.0 NOISE AND VIBRATION

14.1 REGULATORY OVERVIEW

The Federal Noise Control Act of 1972 (42 USC §4901 et. seq.) was enacted by Congress to promote an environment that is free from noise that jeopardizes the health and welfare of the nation. The Act was established to provide a means for coordinating federal research and activities in noise control, to authorize the establishment of noise emission standards for products distributed in commerce, and to provide information to the public respecting the noise emission and noise reduction characteristics of such products. The Quiet Communities Act of 1978 (42 USC §4913) directed the federal government to develop and disseminate noise control information and educational materials to the public, conduct research into the effects of noise on humans, animals, wildlife, and property, and investigate the economic impact of noise on property and human activities.

Federal regulations that have been promulgated as a result of the Noise Control Act generally regulate the noise produced by transportation related equipment such as locomotives, trucks, and construction equipment (40 CFR 201-211). In addition, requirements are given for product noise labeling and hearing protection standards. Federal regulations governing low noise emission requirements for products exclude any rockets or equipment which are designed for research, experimental, or developmental work to be performed by NASA (40 CFR 203.1). However, NASA LaRC's policy is to seek to minimize noise levels, thereby reducing the potential for undesirable noise levels and related problems (LAPG 2710.1, July 1999).

The Noise Control Act directed the Environmental Protection Agency (EPA) to publish information about the effects of different qualities and quantities of noise and to define acceptable levels of noise under various conditions that would protect public health and welfare with an adequate margin of safety. The noise guidelines published by the EPA identify a day/night sound level (Ldn)[1] of less than 55 dBA as adequate to protect outdoor activities against interference and annoyance due to noise (EPA, 1974).

The Commonwealth of Virginia has not enacted noise control regulations. However, the City of Hampton has enacted a Noise Ordinance (Hampton City Code, Section 22 Noise, 1992) which prohibits creating any unreasonably loud or disturbing noise of such character, intensity, or duration that may be detrimental to the life or health of the individuals within the city limits. The City has defined a Noise District which includes all lands within the 65 dBA Ldn contour of the Noise Contour Map of Langley Air Force Base, Air Installation Compatible Use Zone (AICUZ) report prepared by Langley Air Force Base (LAFB, 1997). The Noise Contour Map is shown in Figure 14-1. The Hampton City Code requires residences within the Noise District have adequate

[1] The Ldn parameter is preferred by the EPA for assessing environmental noise impacts (EPA, 1974). It is the energy average of all the noise occurring throughout the 24-hour day but with a 10-decibel penalty added to the nighttime hours between 10 p.m. and 7 a.m. to account for the greater sensitivity of people to noise at night. This guideline level is commonly used as a basis for judging the acceptability of facility noise at residential and other sensitive receptors. Other governmental agencies such as the Department of Housing and Urban Development (HUD) and the Department of Defense (DOD) define outdoor Ldn Levels up to 65 dBA as acceptable for residences.

acoustical insulation to achieve a maximum interior noise level of 45 dBA to guard against any adverse human health effects or disturbances due to excessive noise.

14.2 NASA LANGLEY OPERATIONS

NASA conducts its research and testing operations with great caution and awareness to restrict noise within the guidelines established by the Occupational Safety and Health Act of 1970 (29 CFR 1910 et. seq.) and minimizes environmental noise impacts to the extent possible. LaRC maintains a Noise Control and Hearing Conservation Program, which is described in LAPG 2710.1.

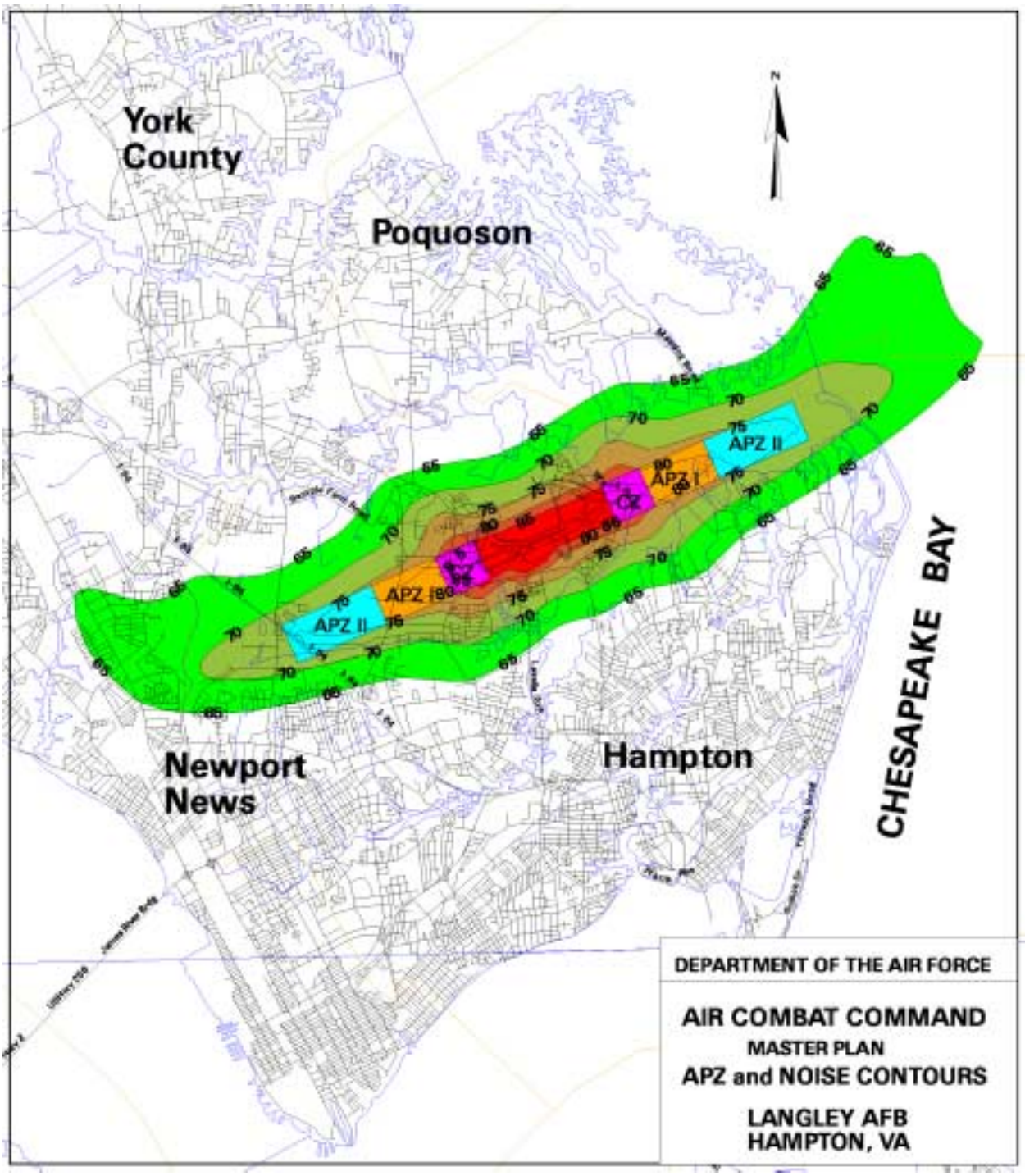
Primary noise sources at NASA LaRC include the wind tunnels, the compressor stations, and the substations. Most of the wind tunnels are closed-loop tunnels in which the test gas medium is recirculated and the noise generated by the tunnel is contained largely within the building. In addition, many of the laboratories and shops have equipment that produce high interior noise levels within the buildings.

Sound intensity attenuates with distance from the source, so the impact of sound generated is greatly affected by the distance from the source to the receptor. Since the land surrounding NASA LaRC is basically flat, the effects of terrain on propagating sound waves have been ignored in sound analyses performed at NASA LaRC. Meteorological conditions, however, can have a great effect on sound wave intensity. Acoustic focusing can be caused when the speed of sound increases with altitude due to certain wind speeds and temperature profiles. When this occurs, sound waves are refracted and combine with the sound wave traveling along the ground, causing higher noise levels at any given distance than would normally be expected. Many of the facilities operate only at certain times of the year, often for periods of ten minutes or less.

Although the fighter aircraft operating from Langley Air Force Base are by far the dominant and most wide spread noise source in the area, several NASA LaRC facilities located close to the NASA LaRC property line produce noise levels higher than ambient levels outside the property line. Several of the tunnels operate for extended hours during nighttime due to large electrical power requirements. The major noise sources at NASA Langley Research Center include:

- 16-Foot Transonic Tunnel (Building 1146A-D)
- Jet Exit Test Facility (Building 1234)
- National Transonic Facility (Building 1236)
- 8-Foot High Temperature Tunnel (Building 1265A-E)
- Frequency Converter Building (Building 1235)
- Landing Loads Compressor and Control Building (Building 1258)
- 14x22-Foot Subsonic Tunnel (Building 1241)
- 8-Foot Transonic Pressure Tunnel (Building 640)
- Transonic Dynamics Tunnel (Building 648)

FIGURE 14-1 - NOISE CONTOUR MAP



Several wind tunnel operations at NASA LaRC, such as the 8-Foot High Temperature Tunnel, produce noticeable vibrations outside NASA LaRC property. There is a possibility of impact to surrounding communities from high noise levels and vibrations, particularly during adverse atmospheric conditions.

Due partly to the uniqueness of the NASA LaRC tunnels, a lack of major residential development within the Hampton Noise District, and the fact that NASA LaRC and LAFB have preceded most residential developments in the area, there have not been significant complaints regarding noise from NASA LaRC operations.

NASA LaRC conducted a comprehensive environmental noise survey (Ebasco, 1995) of its major noise producing sources during 1994 to establish noise levels resulting from Center operations, to determine the acceptability of the noise by the local community, and to develop appropriate mitigative measures as required. The survey used the Botsford procedure to rate the noise from each source and to determine the potential of community annoyance from these noise sources. Table 14-1 lists the facilities and their operating noise levels measured at five off-site properties in the nearby community around NASA Langley Research Center.

Table 14-1
Facility Operating Noise Levels and Potential for Community Annoyance

Building No.	Noise Source	Date Measured	Highest Operating Noise Level dBA	Botsford Potential for Community Noise Annoyance
641	8-Foot Transonic Pressure Tunnel	7/13/94	48	None
648	Trans Dynamic Tunnel	7/14/94	47	None
1146A	16-Foot Transonic Tunnel	12/14/94	72	Few
1212C	14x22-Foot Subsonic Tunnel	7/24/94	56	None
1234	Jet Exit Test Facility	7/14/94	66	None
1235	Frequency Converter Building	7/14/96	53	None
1236	National Transonic Facility	12/8/94	69	Few
1241	Drive Control Facility	12/14/94	58	None
1244	Hangar/Run-up Pad with NASA Use	7/18/94	57	None
1244	Run-up Pad with LAFB Use	7/18/96	81	Few
1261	Landing Loads Track Shop Building	7/22/94	49	None
1265	8-Foot High Temperature Tunnel	7/18/94	79	None

The survey indicates the 16-Foot Transonic Tunnel and the National Transonic Facility produce noise levels with the potential to generate a "few" noise complaints from the adjacent community. Although noise levels from NASA aircraft using the Run-up pad were determined to have no potential for community annoyance, noise levels during the use of the Run-up pad by Langley Air Force Base fighter jets were determined to have a potential for community annoyance. The noise level measured from the 8-Foot High Temperature Tunnel was similar to the noise level generated by Air Force fighter jets

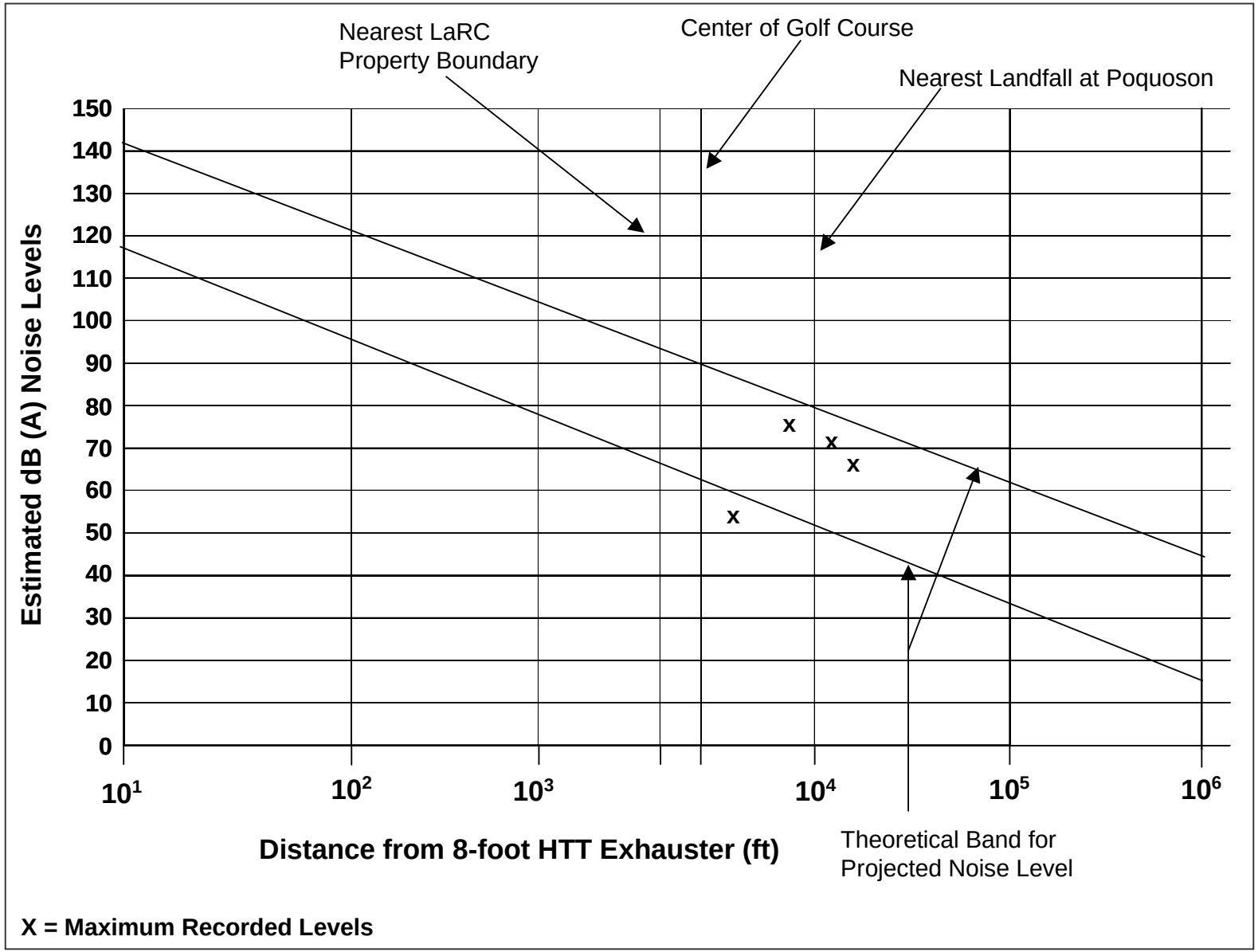
using the Run-up pad, although the Botsford potential for community annoyance was "none" from the 8-Foot High Temperature Tunnel operation. The reported difference in the Botsford potential between this Tunnel operation and the jet operations is the large low frequency of the sound from the Tunnel which produces vibration, and the relatively short duration (less than 100 seconds per test run) and infrequency of Tunnel operations (approximately twice a week). Jet noise from the Run-up pad extend for a much longer duration (14 minutes) than noise from the 8-Foot High Temperature Tunnel. Figure 14-2 shows theoretical calculations for likely noise levels from this tunnel operation. These calculations indicate that noise levels between 55 dBA and 82 dBA may be possible near the City of Poquoson. These are comparable to actual measurements of 51 dBA to 79 dBA in 1994 (Ebasco, 1995).

The Center's Industrial Hygiene staff in the Office of Safety and Facility Assurance monitors noise levels at NASA Langley Research Center facilities. They survey and monitor noise levels during monthly and annual audits of facilities and in response to NASA LaRC employee complaints. The Industrial Hygiene staff insures proper controls are in place to protect Center personnel from exposure to excessive noise levels in accordance with OSHA requirements.

14.3 MAJOR ENVIRONMENTAL CONSIDERATIONS FOR PROPOSED ACTIONS

Any proposed operations or changes in existing operations that may generate significant amounts of noise should provide an estimate of the effect of noise levels and develop a program to manage the noise. The project proponent should coordinate the project or program with the Environmental Management Office. The Facilities Master Plan should be consulted to ensure that high noise manufacturing facilities, research operations and other continuous noise sources are located away from the more densely populated areas of the site to protect the low ambient noise levels.

FIGURE 14-2
8-FOOT HIGH TEMPERATURE TUNNEL NOISE LEVELS



15.0 ENERGY

15.1 REGULATORY OVERVIEW

The Center's current energy conservation objectives are derived from four governing directives, Public Law 100-615 (Fall, 1988), Energy Policy Act of 1992, and Presidential Executive Order 13123, June 3, 1999 (supercedes Executive Orders 12902, March 8, 1994 and 12759, April 17, 1991). These objectives are for each Agency to:

- Reduce its greenhouse gas emission attributed to facility energy use by 30 percent by 2010 compared to such emission levels in 1990.
- Reduce energy consumption per gross square foot of its non-mission variable facilities, by 30 percent by 2005 and 35 percent by 2010 relative to 1985.
- Reduce energy consumption per square foot, per unit production, or other unit as applicable for mission variable facilities by 20 percent by 2005 and 25 percent by 2010 relative to 1990.
- Reduce water consumption and associated energy use in facilities as set by the Agency.
- Strive to expand the use of renewable energy within its facilities and its activities by implementing renewable energy projects and by purchasing electricity from renewable energy sources.
- Reduce the use of petroleum within its facilities.
- Reduce total energy use and associated greenhouse gas and other air emission, as measured at the source.

15.2 NASA LANGLEY OPERATIONS

15.2.1 Energy Consumption

NASA LaRC used approximately 186.8 million kilowatt-hours (kWh) of electricity during FY 2000. Mission variable operations used around 46.3 percent of electrical energy. Energy Intensive facilities used around 24.8 percent of electrical energy. NASA LaRC uses #2 fuel oil and natural gas primarily to generate steam to provide heat and back-up power, for research activities. In FY 2000, NASA LaRC facilities used approximately 12,000 gallons of #2 fuel oil and 157,184,000 cubic feet of natural gas. NASA LaRC also purchased about 345.2 Mlbs of steam from the City of Hampton RFSGF in FY 2000. Approximately 79.4 percent of the total facility energy usage at NASA LaRC is in the form of electricity (NASA 2000 Utility and Supply Reports).

The Center used approximately 91,000 gallons of jet fuel for its planes and 83,000 gallons of gasoline and diesel fuel for its on-site fleet of vehicles in FY 2000. Natural gas and bottled propane are used for operations in its research programs, which provide about 0.2 percent of total energy consumption at the Center (NASA LaRC 2000 Utility and Supply Reports).

15.2.2 Energy Management and Conservation

Historical Program

A comprehensive energy conservation and management program has been in operation since the early 1970s at the Center. An assortment of projects, controls, hardware systems, and management policies are in place to facilitate energy monitoring and conservation. The salient features of the program include the following:

- Refused-fired steam generation facility jointly funded by NASA, LAFB, and the City of Hampton which provided nearly 78.5 percent of the Center's steam requirement in FY 2000;

- Utility control system for automated monitoring and on/off control of the heating, ventilating, and air conditioning (HVAC) systems in major facilities;

- Radio control system for automated on/off control of HVAC systems in remote locations; and,

- Electronic monitoring and reporting system of electrical energy usage.

Current System and Future Plans

The energy management system is composed of two segregated elements - the electrical power usage monitoring system and the utility control system (UCS). Electrical power usage monitoring and reporting is accomplished through electronic power sensors that are input to an automated processing system which provides data on current usage, comparisons of actual and planned usage, and accumulated totals as well as excessive power usage. The UCS implements energy control by on/off actions using strategies based on day/night cycles, weekday/weekend cycles, and outside temperature thresholds for HVAC systems. The NASA LaRC Energy Manager oversees the program.

The Center is aggressively developing strategies to meet the challenges of the new energy mandates without unduly compromising research productivity or employee comfort. The Center has a 15-year energy conservation plan that is updated annually.

15.3 MAJOR ENVIRONMENTAL CONSIDERATIONS FOR PROPOSED ACTIONS

Proposed actions should consider energy usage and energy conservation should be addressed during the planning stages of the project. The LaRC Energy Manager should be consulted to evaluate the energy requirements for any new project.

16.0 RELEASE REPORTING UNDER THE EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT (EPCRA) AND COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT (CERCLA)

16.1 REGULATIONS

16.1.1 Emergency Planning and Community Right-to-Know Act (EPCRA)

The Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 was enacted in response to a growing concern about the effect of chemical releases on communities.

Although enacted as part of the Superfund Amendments and Reauthorization Act of 1986 (SARA Title III), EPCRA is a free-standing law. It is intended to encourage and support emergency planning efforts at the state and local level, and provide citizens and local governments with information concerning potential chemical hazards present in their communities. LaRC is required to comply with all sections of EPCRA as stated by Executive Order 13148 dated April 22, 2000.

16.1.1.1 Emergency Planning Notification

EPCRA (SARA Sections 302 and 303) requires that facility owners or operators notify the State Emergency Response Committee (SERC) if their facility qualifies as an Emergency Planning Facility. The criteria for qualification is any facility that has on site, at any given time, a quantity of an Extremely Hazardous Substance (EHS) that is equal to or greater that its threshold planning quantity (TPQ). The facility must notify the SERC within 60 days of first meeting this qualification.

An Emergency Planning Facility must designate a Facility Emergency Coordinator and provide the name of that individual to the Local Emergency Planning Committee (LEPC) or the SERC if there is no established LEPC.

16.1.1.2 Spill Reporting

EPCRA (SARA Section 304 and CERCLA Section 103) requires that the owner or operator of a facility must notify the appropriate authorities in the case of an accidental release of an EHS or CERCLA-defined hazardous substance equal to or greater than its reportable quantity (RQ). This notification must be made immediately by the owner or designated representative. See Chapter 14 of the Environmental Program Manual (LAPG 8800.1) for procedure information on spills and reporting.

As soon as possible after the release, EPCRA requires a written follow-up report for any release that requires immediate notification to the SERC and the LEPC.

16.1.1.3 Inventory Reporting

Facilities that have hazardous chemicals are required by the Occupational Safety and Health Act (OSHA) to maintain Material Safety Data Sheets (MSDSs) for the hazardous chemicals. EPCRA (SARA Sections 311) requires the owner or operator of these facilities to:

- Submit MSDSs or a list of MSDS chemicals within 90 days from the day the facility first has on-hand the threshold quantities, and

- Submit annually (by March 1) a hazardous chemical inventory form to the Virginia Emergency Response Council, the Local Emergency Planning Committee, and the local Fire Department that has jurisdiction over the facility.

16.1.1.4 Toxic Release Inventory

EPCRA (SARA Section 313) also requires a report of emissions of toxic chemicals from facilities that manufacture, process, import or otherwise use a listed toxic chemical in excess of specific threshold quantities.

16.1.2 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides EPA with the authority to respond to releases or threatened releases of hazardous substances, pollutants, or contaminants that may endanger human health or the environment. CERCLA also requires that EPA maintain the National Priorities List (NPL), a list of sites across the United States that require remedial action due to releases or threatened releases of hazardous substances. Finally, CERCLA requires reporting of releases, establishes the liability of persons responsible for releases of hazardous substances, and established a trust fund to provide for cleanup when no responsible party can be identified.

16.1.2.1 CERCLA Reporting

Reporting the release of toxic chemicals is required for NASA and its contractors at NASA LaRC under CERCLA. This law and implementing regulations (40 CFR 355.10 et seq.; 40 CFR 372.1 et seq.) establish a list of hazardous substances and a reporting quantity as well as reporting requirements for release of toxic chemicals.

16.2 NASA LANGLEY OPERATIONS

Emergency response requirements under CERCLA apply to the operation of NASA LaRC. Under CERCLA, facility personnel and contractors are responsible for reporting releases of reportable quantities (RQ) of hazardous substances to the EMO who reports

to the National Response Center within 24 hours. Reportable quantities are specified on a constituent-by-constituent basis in 40 CFR Table 302.4.

16.2.1 EPCRA Reports

Executive Order 13148 requires all Federal agencies to comply with EPCRA reporting requirements. NASA LaRC has complied with the reporting requirements of SARA and EPCRA and submits the information to the State in a Tier II format. Additional information is provided when requested by State or Federal agencies. The EMO is responsible for maintaining all information relating to NASA LaRC release reporting. While the specific number and types of hazardous materials reported may vary year to year, materials reported in past years include fuels (#2 fuel oil, diesel, gasoline, JP-5), gases (argon, carbon dioxide, propane, methane, helium, nitrogen, oxygen), liquids (ethylene glycol, propylene, hydrogen chloride, chlorine, HCFC 134-a and CFC-113), and solids (lead and sodium chloride).

16.2.1.1 Toxic Chemical Release Inventory

Toxic chemical releases are reported by NASA LaRC as required by Section 313 of EPCRA. LaRC submitted this information on EPA Form R for the first time July 1, 1995. This reporting is required to provide the public with information on the release of toxic substances to the environment in the reporting year. Facilities must report the quantities of both routine and accidental releases of listed chemicals, as well as the maximum amount of the listed chemical onsite during the calendar year and the amount transferred offsite. The only chemical reported by NASA LaRC has been dichlorodifluoromethane. It is anticipated that lead will have to be reported on Form R for reporting year 2000.

Table 16-1
Toxic Chemical Releases Reported by NASA LaRC

Report For Year	Chemical	CAS #
2000	Lead and Lead Compounds	7439-92-1
1999	No Form R Required	N/A
1998	No Form R Required	N/A
1997	No Form R Required	N/A
1996	Dichlorodifluoromethane	75-71-8
1995	Dichlorodifluoromethane	75-71-8

16.2.2 CERCLA Reports

Preliminary Assessments/Site Inspections Under CERCLA

In 1988, NASA LaRC conducted a Preliminary Assessment (PA) as required under Section 120(d) of CERCLA at the Center (Ebasco, 1988). The PA identified seven potentially contaminated sites for further investigation. Site Investigations (SIs) were carried out at three of these sites to develop preliminary Hazard Ranking System (HRS)

scores as defined by the EPA (Ebasco, 1989). These sites included the Pyrotechnics Area (now known as the Chemical Waste Pit), Construction Debris Landfill, and the Area E Warehouse. In addition, three other sites (Tabbs Creek, Stratton Substation and portion of the East and West area stormwater system) were identified for further study as a result of other Center investigations. In 1991, the EPA conducted a site analysis of NASA LaRC and LAFB and identified 32 potentially contaminated sites at the two installations. Seven of these sites were located at NASA LaRC. National Priorities List Sites at NASA Langley are listed in Table 16-2.

Table 16-2
LaRC National Priorities List Sites

Site Description	Status
Site 17 - Area E Warehouse	Complete
Site 14 - Stratton Substation	Complete
Stormwater System*	Complete
Tabbs Creek	Complete
Site 2 - Construction Debris Landfill	RI/FS
Site 1 - Chemical Waste Pit	No Further Action
* Federal Facilities Compliance Agreement, II-FF-CWA-003	

Additional Sites Identified by EPA Site Analysis
NASA LaRC, TS-PIC-90918
October 1991

Site Description	Status
Site 11 - Building 1199	DD Complete
Site 6 - Building 1164	DD Complete
Site 4 - Open Storage Area	DD being prepared
Site 16 - Fill Area	DD being prepared

Additional Sites Identified by EPA Site Analysis
NASA LaRC, TS-PIC-90918
October 1991 cont.

Site Description	Status
Site 15 - Treatment Facility	DD being prepared
Site 13 - Dump (Building 1250)	DD being prepared
Site 3 - Dump (Building 1156)	DD being prepared

Note: DD Decision Document PP Proposed Plan
RI/FS Remedial Investigation/Feasibility Study ROD Record of Decision

In April 1993, the EPA approved and released the Hazard Ranking System (HRS) scoring package for the NASA LaRC/LAFB site. Based on final scoring of the sites, NASA LaRC was jointly listed with LAFB on the NPL on April 1, 1994. Cleanup of the storm drain which contaminated nearby Tabbs Creek has been completed. Cleanup of the storm drain system, covered under a 1990 Federal Facilities Compliance agreement, was completed in July 1996 for West area facilities and December 1996 for East area facilities on LAFB. NASA LaRC has studied five of the sites (Area E Warehouse, Chemical Waste Pit, Construction Debris Landfill, Stratton Road Substation, and Tabbs Creek) under a 1993 NPL Federal Facilities Agreement (NASA

LaRC, 1993b). NASA LaRC has signed Records of Decision for the Area E Warehouse area, Stratton Substation and Tabbs Creek. It has been determined that no further action is necessary at the Chemical Waste Pit. Studies are currently being completed at the Construction Debris Landfill site. The remaining seven sites (dumps near Buildings 1156 and 1250, Open Storage Area, Buildings 1164 and 1199, the Treatment facility, and the Fill Area) have been studied under the NASA LaRC NPL Facility Management Plan (Ebasco, 1996) and decision documents for two of the sites have been completed and signed. Decision documents for the remaining sites are in draft form and are under review. All known petroleum-contaminated sites have been remediated as part of the underground storage tank (UST) work conducted at the Center (Ebasco, 1994b).

16.3 MAJOR ENVIRONMENTAL CONSIDERATIONS FOR PROPOSED ACTIONS

All construction and testing operations must be coordinated through the NASA LaRC Environmental Management Office (EMO) so that environmental impacts can be properly assessed. Contact with EMO is necessary to ensure that no proposed actions jeopardize compliance with NEPA, RCRA, EPCRA, or CERCLA regulations. The following release reporting issues need to be considered for proposed actions.

- Does any new activity impact any site that was investigated under the preliminary analysis or that has been further investigated under the site investigation?

- Will any new activity result in the need for additional reporting under EPCRA? Refer to the NASA LaRC Standard Operating Procedure for preparation of MSDSs, the NASA LaRC hazard communication Standard Program, and the NASA LaRC personnel training requirements that are in place to ensure the emergency response reporting and notification requirements are met.

- Are any proposed facilities to be located in areas of identified contamination? If so, measures to cleanup the area prior to new construction should be addressed.

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APPENDIX II-1

HAZARDOUS AIR POLLUTANTS REGULATED UNDER TITLE III OF THE CAAA

CAS #	HAZARDOUS AIR POLLUTANT
79-34-5	1,1,2,2-tetrachloroethane
79-00-5	1,1,2-trichloroethane
75-34-3	1,1-dichloroethane
57-14-7	1,1-dimethylhydrazine
120-82-1	1,2,4-trichlorobenzene
96-12-8	1,2-dibromo-3-chloropropane
107-06-2	1,2-dichloroethane
122-66-7	1,2-diphenylhydrazine
106-88-7	1,2-epoxybutane
75-55-8	1,2-propylenimine
106-99-0	1,3-butadiene
542-75-6	1,3-dichloropropene
1120-71-4	1,3-propane sultone
123-91-1	1,4-dixoane
540-84-1	2,2,4-trimethylpentane
72-55-9	2,2-bis(p-chlorophenyl)-1,1-dichloroethylene
1746-01-6	2,3,7,8,-tetrachlorodibenzo-p-dioxin
95-95-4	2,4,5-trichlorophenol
88-06-2	2,4,6-trichlorophenol
51-28-5	2,4,-dinitrophenol
94-75-7	2,4-D (dichlorophenoxy acetic acid) (including esters & salts)
121-14-2	2,4-dinitrotoluene
95-80-7	2,4-toluene diamine
53-96-3	2-acetylaminofluorene
126-99-8	2-chloro-1,3-butadiene
532-27-4	2-chloroacetophenone
79-46-9	2-nitropropane
91-94-1	3,3'-dichlorobenzidene
119-90-4	3,3'-dimethoxybenzidine
119-93-7	3,3'-dimethyl benzidine
101-14-4	4,4-methylene bis (2-chloroaniline)
101-77-9	4,4-methylene dianiline
534-52-1	4,6-dinitro-o-cresol (including salts)
92-67-1	4-aminodiphenyl
92-93-3	4-nitrodiphenyl
100-02-7	4-nitrophenol
75-07-0	acetaldehyde
60-35-5	acetamide
75-05-8	acetonitrile
98-86-2	acetophenone
107-02-8	acrolein
79-06-1	acrylamide
79-10-7	acrylic acid
107-13-1	acrylonitrile
107-05-1	allyl chloride
62-53-3	aniline & homologues
7440-36-0	antimony compounds
7440-38-2	arsenic compounds
1332-21-4	asbestos
71-43-2	benzene
92-87-5	benzidine
98-07-7	benzotrichloride
100-44-7	benzyl chloride
7440-41-7	beryllium compounds
92-52-4	biphenyl
542-88-1	bis-(chloromethyl) ether
57-57-8	b-propiolactone
75-25-2	bromoform
7440-43-9	cadmium compounds
156-62-7	calcium cyanamide
133-06-2	captan
63-25-2	carbaryl
75-15-0	carbon disulfide
56-23-5	carbon tetrachloride
463-58-1	carbonyl sulfide
120-80-9	catechol
133-90-4	chloramben
57-74-9	chlordane
7782-50-5	chlorine
79-11-8	chloroacetic acid
108-90-7	chlorobenzene
510-15-6	chlorobenzilate
67-66-3	chloroform
107-30-2	chloromethyl methyl ether
7440-47-3	chromium compounds
7440-48-4	cobalt compounds
	coke oven emissions
1319-77-3	cresols/cresylic acid
98-82-8	cumene
151-50-8	cyanide compounds[1]
334-88-3	diazomethane
132-64-9	dibenzofurans
84-74-2	dibutyl phthalate
111-44-4	dichloroethyl ether
62-73-7	dichlorvos
111-42-2	diethanolamine
64-67-5	diethyl sulfate
60-11-7	dimethyl aminoazobenzene
79-44-7	dimethyl carbamoyl chloride
68-12-2	dimethyl formamide
77-78-1	dimethyl sulfate
121-69-7	dimethylaniline
131-11-3	dimethylphthalate
117-81-7	di-sec-oxtyl phthalate
106-89-8	epichlorohydrin
140-88-5	ethyl acrylate
100-41-4	ethyl benzene
51-79-6	ethyl carbamate/urethane

CAS #	HAZARDOUS AIR POLLUTANT
75-00-3	ethyl chloride/chloroethane
106-93-4	ethylene dibromide
107-21-1	ethylene glycol
75-21-1	ethylene oxide
96-45-7	ethylene thiourea
151-56-4	ethyleneimine (fine mineral fibers[3])
50-00-0	formaldehyde (glycol ethers[2])
76-44-8	heptachlor
118-74-1	hexachlorobenzene
87-68-3	hexachlorobutadiene
77-47-4	hexachlorocyclopentadiene
67-72-1	hexachloroethane
680-31-9	hexamethylphosphoramide
822-06-0	hexamethylene-1,6-diisocyante
110-54-3	hexane
302-01-2	hydrazine
7647-01-0	hydrogen chloride/hydrochloric acid (gas only)
7664-39-3	hydrogen fluoride
123-31-9	hydroquinone/dihydroxybenzene)
78-59-1	isophorone
7439-92-1	lead compounds
58-89-9	lindane
108-31-6	maleic anhydride
7439-96-5	manganese compounds
108-39-4	m-cresol
7439-97-6	mercury compounds
67-56-1	methanol
72-43-5	methyoxychlor
74-83-9	methyl bromide
74-87-3	methyl chloride
71-55-6	methyl chloroform (1,1,1,-trichloroethane)
78-93-3	methyl ethyl ketone
60-34-4	methyl hydrazine
74-88-4	methyl iodide
108-10-1	methyl isobutyl ketone
624-83-9	methyl isocyanate
80-62-6	methyl methacrylate
1634-04-4	methyl tert butyl ether
101-68-8	methylene bisphenyl isocyanate/MDI
75-09-2	methylene chloride/dichloromethane
108-38-3	m-xylene
91-20-3	naphthalene
7440-02-0	nickel compounds
98-95-3	nitrobenzene
62-75-9	n-nitrosodimethylamine/NDMA
59-89-2	n-nitrosomorpholine/NMOR
684-93-5	n-nitroso-n-methylurea
90-04-0	o-anisidine
95-48-7	o-cresol
95-53-4	o-toluidine
95-47-6	o-xylene
56-38-2	parathion
106-44-5	p-cresol
106-46-7	p-dichlorobenzene/1,4-dichlorobenzene
82-68-8	pentachloronitrobenzene
87-86-5	pentachlorophenol
108-95-2	phenol
75-44-5	phosgene/carbonylchloride
7803-51-2	phosphine
7723-14-0	phosphorus
85-44-9	phthalic anhydride
1336-36-3	polychlorinated biphenyls/arochlors
	polycyclic organic matter/POM[4]
106-50-3	p-phenylenediamine
123-38-6	propionaldehyde
114-26-1	propoxur/baygon
78-87-5	propylene dichloride/1,2-dichloropropane
75-56-9	propylene oxide
106-42-3	p-xylene
91-22-5	quinoline
106-51-4	quinone
	radionuclides (including radon)[5]
7782-49-2	selenium compounds
96-09-3	styrene oxide
100-42-5	styrene, monomer/vinyl benzene
127-18-4	tetrachloroethylene/ perchloroethylene
7550-45-0	titanium tetrachloride
108-88-3	toluene
584-84-9	toluene-2,4-diisocyanate/TDI
8001-35-2	toxaphene/chlorinated camphene
79-01-6	trichloroethylene
121-44-8	triethylamine
1582-09-8	trifluralin
108-05-4	vinyl acetate
593-60-2	vinyl bromide
75-01-4	vinyl chloride/chloroethylene
75-35-4	vinylidene chloride/1,1-dichloroethylene
1330-20-7	xylene isomers and mixtures

NOTE: For all listings above which contain the word "compounds" and for glycol ethers, the following applies: Unless otherwise specified, these listings are defined as including any unique chemical substance that contains the named chemical (i.e., antimony, arsenic, etc.) as part of that chemical's infrastructure.

[1]X'CN where X=H' or any other group where a formal dissociation may occur. For example KCN or $Ca(CN)_2$.

[2]Includes mono- and di- ethers of ethylene glycol, diethylene glycol, and triethylene glycol R-(OCH_2CH)n-OR'
where: n = 1, 2, or 3
R = alkyl or aryl groups
R' = R, H, or groups which, when removed, yield glycol ethers with the structure: R-(OCH_2CH)n-OH.
Polymers are excluded from the glycol category.
[3]Includes mineral fiber emissions from facilities manufacturing or processing glass, rock, or slag fibers (or other mineral derived fibers) of average diameter 1 micrometer or less.
[4]Includes organic compounds with more than one benzene ring, and which have a boiling point greater than or equal to 100°C.
[5]A type of atom which spontaneously undergoes radioactive decay.

In 1987, the United States ratified the Montreal Protocol, an international treaty to control substances that deplete the ozone layer in the stratosphere. The Treaty calls for reduced production, consumption, and eventual phaseout of specific compounds responsible for depleting stratospheric ozone. In support of the Montreal Protocol, the CAAA requires the complete phaseout of CFCs and other ozone depleting compounds by the year 2000.

In 1997, EPA finalized two new air pollution standards for particulate matter and ozone. The current particulate standard, PM-10, regulates emissions of particulates with diameters less than 10 microns. The new standard, PM 2.5, covers emissions of even finer particles with diameters of less than 2.5 microns. The new ozone standard changes the existing standard of 0.12 parts per million over a 1-hour average to 0.08 parts per million over an 8-hour average. As of May 14, 1999, the U.S. Court of Appeals has set aside both of these new air pollution standards, however EPA is appealing the decision.

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APPENDIX V-1

WILDLIFE OF THE LOWER VIRGINIA PENINSULA, LANGLEY RESEARCH CENTER, AND LANGLEY AIR FORCE BASE

I. INTRODUCTION

The following lists detail the wildlife found on the lower Virginia Peninsula, including NASA Langley Research Center and Langley Air Force Base. They are based on the 1973 "Preliminary Survey of the Flora and Fauna of Langley Air Force Base" by Byrd and Ware, 1985 "Virginia's Amphibians and Reptiles, A Distributional Survey" by Tobey, 1994 "Survey for Bald Eagles and Peregrine Falcons at Langley Air Force Base" by GeoMarine, Inc. (initiated by the Army Corps of Engineers, Ft. Worth District), and the 1995 "Baseline Biological Survey of Terrestrial and Aquatic Habitats at NASA Langley Research Center, With Special Emphasis on Endangered and Threatened Flora and Fauna" by Old Dominion University.

Notes:

Status	Habitat
A - Abundant	HF - Hardwood Forest
C - Common	MPH - Mixed Pine/Hardwood Forest
U - Uncommon	PF - Pine Forest
R - Rare	AF - Alluvial Forest
T - Transient	M - Marsh
WR - Winter Resident	OW - Open Water
SR - Summer Resident	S - Successional
PR - Permanent Resident	A - Agricultural
	D - Developed Land
	G - General (may be found in most of the above)

AMPHIBIANS			
Species	**Common Name**	**Status**	**Habitat**
1. Species which occur both north and south of Hampton Roads			
Amphiuma means	Two-toed amphiuma	U	Freshwater Streams
Notophthalamus viridescens	Red-spotted newt	C	Freshwater Ponds
Ambystoma opacum	Marbled salamander	U	HF, MPH, PF, AF
Plethedon cinereus cinereus	Red-backed salamander	C	HF, MPH, PF, AF, D
Plethedon glutinosus glutinosus	Slimy salamander	C	HF, MPH, PF, AF, D
Pseudotriton montanus montanus	Eastern mud salamander	U	Freshwater Streams
Eurycea longicauda guttolineata	Three-lined salamander	U	Freshwater Streams
Scaphiopus holbrooki	Eastern spadefoot toad	C	HF, MPH, PF, S, A, D
Bufo fowleri	Fowler's toad	C	G (excluding OW and M)
Bufo terrestris	Southern toad	C	G (excluding OW and M)
*Gastrophryne carolinensis**	Eastern narrow-mouth toad		
Hyla crucifer	Spring peeper	C	G (excluding OW and M)
Hyla femoralis	Pinewood's treefrog	C	PF, HF, MPH, AF, S
Hyla versicolor versicolor	Eastern gray treefrog	C	G (excluding OW and M)
Hyla cinerea	Green treefrog	C	Pond/Stream edge
Pseudacris nigrita nigrita	Southern chorus frog	U	Pond/Stream edge

AMPHIBIANS			
Species	**Common Name**	**Status**	**Habitat**
Pseudacris triseriata feriarum	Upland chorus frog	C	Pond/Stream edge
Pseudacris brimleyi	Brimley's chorus frog	U	Pond/Stream edge
*Rana utricularia**	Southern leopard frog		
2. Species which probably occur both north and south of Hampton Roads (northern records)			
Ambystoma maculatum	Spotted salamander	U	HF, MPH, PF, AF
Hemidactylium scutatum	Four-toed salamander	U	Freshwater Swamps
Pseudotriton ruber ruber	Northern red salamander	U	Freshwater streams
Acris crepitans crepitans	Northern cricket frog	C	Freshwater streams/ponds
3. Species which probably occur both north and south of Hampton Roads (southern records)			
Siren lacertina	Greater siren	U	Freshwater streams
4. Species probably occurring in the lower Peninsula, distribution limited to the area north of Hpt. Roads			
Eurycea bislineata bislineata	Northern two-lined salamander	C	Freshwater streams
Bufo americanus	American toad	C	G (excluding OW and M)
Acris crepitans crepitans	Northern cricket frog	C	Pond/Stream edge
5. Species expected to occur at NASA LaRC, as identified by Tobey (1985) and ODU (1995)			
Rana clamitans	Green frog		
Hyla chrysocelis	Gray treefrog		
Desmognathus fuscus	Dusky salamander		
* *Note*: These species were identified/collected at LaRC during ODU's 1994 biological survey.			

REPTILES			
Species	**Common Name**	**Status**	**Habitat**
1. Species which occur in the lower Virginia Peninsula			
Lepidochelys kempi+	Kemp's (Atlantic) Ridley sea turtle	R	Mouth of Hampton Roads
Chelydra serpentina	Snapping turtle	C	Freshwater Streams/Ponds
Sternothaerus odoratus	Stinkpot	C	Fresh/brackish Streams, Swamps
Kinosternon subrubrum subrubrum	Mud turtle	C	Fresh/brackish Streams, Swamps
Clemmys guttata	Spotted turtle	U	Freshwater Streams/Ponds
Terrapene carolina carolina	Box turtle	C	HF, MPH, PF, AF, S, A, D
Chrysemys picta picta	Painted turtle	C	Freshwater Ponds/Streams, Rivers
Pseudemys scripta scripta	Yellow-bellied turtle	C	Freshwater Ponds/Streams, Rivers
Pseudemys rubriventris	Red-bellied turtle	U	Freshwater ponds/Streams, Rivers
*Malaclemys terrapin terrapin**+	Northern diamondback terrapin	C	M, Saltwater
Sceloporus undulatus hyacinthinus	Eastern fence lizard	C	HF, MPH, PF, AF, S, A, D
Ophisaurus ventralis +	Glass snake lizard	C	A, MPH, Pond edges
Cnemidophorus sexlineatus	Six-lined racerunner	C	A, S, D, PF

REPTILES			
Species	**Common Name**	**Status**	**Habitat**
Eumeces fasciatus	Five-lined skink	C	HF, MPH, PF, S, D
Eumeces laticepss	Broad-headed skink	C	HF, MPH, PF, S, D
Lygosoma laterale	Ground skink	C	HF, MPH, PF, S, D
Eumeces inexpectatus	Southeastern five-lined skink	C	AF, HF
Carphophis amoenus amoenus	Worm snake	C	HF, MPH, PF, D
Abastor erythrogrammus	Rainbow snake	U	Lake and Stream Fossorial
Diadophis punctatus	Eastern ringneck snake	C	HF, MPH, PF, AF, S, A,D
Heterodon platyrhinos platyrhinos	Eastern hognose snake	C	OW, S, A
Opheodrys aestivus	Rough green snake	C	G (excluding OW and M)
Natrix taxispilota	Brown water snake	U	M, Freshwater Ponds
Natrix sipedon sipedon	Northern water snake	C	M, Freshwater Ponds
Storeria dekayi dekayi	Dekay's snake	C	D, S, MPH
Storeria occipitomaculata	Red-bellied snake	U	HF, MPH, PF
Thamnophis sirtalis sirtalis	Eastern garter snake	C	MPH, AF, M, A, D
Thamnophis sauritus sauritus	Eastern ribbon snake	C	Freshwater edges
Haldea striatula	Rough earth snake	U	G (excluding OW and M)
Haldea valeriae	Smooth earth snake	U	G (excluding OW and M)
Coluber constrictor constrictor	Northern black racer	C	HF, MPH, PF, AF, S, A, D
Elaphe guttata guttata	Corn snake	R	G (excluding OW and M)
Elaphe obsoleta obsoleta	Black rat snake	C	G (excluding OW and M)
Lampropeltis getulus getulus	Eastern kingsnake	C	G (excluding OW and M)
Lampropeltis doliata temporalis	Scarlet kingsnake	U	S, A, HF, Fossorial
Lampropeltis calligaster rhombomaculata	Mole snake	R	S, A, HF, Fossorial
Cemophora coccinea copei	Scarlet snake	U	S, A, HF, Fossorial
*Nerodia spp.**	Water snake		
Agkistrodon contortrix contortrix	Southern copperhead	C	HF, AF, MPH, D, A, S, PF
Agkistrodon piscivorus piscivorus	Eastern cottonmouth	U	Freshwater Ponds, Swamps
Crotalus horridus atricaudatus+	Canebrake rattlesnake	R	AF, Canebrakes
2. Species which probably occur both north and south of Hampton Roads (southern records)			
Pseudemys floridana	Cooter	R	M,Freshwater Ponds/Streams, Rivers
Natrix erythrogaster erythrogaster	Red-bellied water snake	R	Freshwater Ponds/Streams
* *Note*: These species were identified/collected at LaRC during ODU's 1994 biological survey. + *Note*: These species are either Federal- or State-listed as endangered, threatened, or special concern, 1998.			

BIRDS			
Species	**Common Name**	**Status**	**Habitat**
Species which occur in areas immediately adjacent to Langley Research Center and Langley Air Force Base			
Olor columbianus	Whistling swan	WR	
*Cygnus columbianus**	Tundra swan		
Branta canadensis	Canadian goose	WR	
Chen hyperborea	Snow goose	WR	
Branta bernicla	Brant	WR	

BIRDS			
Species	**Common Name**	**Status**	**Habitat**
Dendrocygna bicolor	Fulvous tree duck	WR	
Anas rubripes	Black duck	WR	
Aix sponsa	Wood duck	SR	
Aythya collaris	Ring-necked duck	WR	
Oxyura jamaicensis	Ruddy duck	WR	
Anas platyrhynchos	Mallard	WR	
Anas stepera	Gadwall	WR	
Anas acuta	Pintail	WR	
Anas carolinensis	Green-winged teal	WR	
Anas discors	Blue-winged teal	T	
Mareca americana	American widgeon	WR	
Spatula clypeata	Shoveler	WR	
Aythya americana	Redhead	WR	
Aythya valisineria	Canvasback	WR	
Aythya marila	Greater scaup	WR	
Aythya affinis	Lesser scaup	WR	
Gavia immer	Common loon	WR	
Gavia stellata	Red-throated loon	WR	
Podiceps auritus	Horned grebe	WR	
Podiceps grisegena	Red-necked grebe	T	
Podilymbus podiceps	Pie-billed grebe	PR	
Phalacrocorax auritus	Double-crested cormorant	T	
Ardea herodias	Great blue heron	PR	
Florida caerulea+	Little blue heron	T	
Hydranassa tricolor	Louisiana heron	SR	
Nycticorax nycticorax	Black-crowned night heron	WR	
Nyctanassa violacea+	Yellow-crowned night heron	SR	
Bubulcus ibis	Cattle egret	T	
Casmerodius albus	Common egret	SR	
Leucophoxy thula	Snowy egret	SR	
Ixobrychus exilis	Least bittern	SR	
Botaurus lentiginosus	American bittern	T	
Plegadis falcinellus+	Glossy ibis	T	
Bucephala clangula	Common goldeneye	WR	
Bucephala albeola	Bufflehead	WR	
Clangula hyemalis	Oldsquaw	WR	
Somateria mollissima	Common eider	WR	
Somateria spectabilis	King eider	WR	
Melanitta deglandi	White-winged scoter	WR	
Melanitta perspicillata	Surf scoter	WR	
Oidemia nigra	Common scoter	WR	
Mergus serrator	Red-breasted merganser	WR	
*Lophodytes cucullatus**	Hooded merganser		
Cathartes aura	Turkey vulture	PR	
Coragyps atratus	Black vulture	PR	
Accipiter striatus	Sharp-shinned hawk	T	
Accipiter cooperi	Cooper's hawk	T	
Buteo jamaicensis	Red-tailed hawk	PR	
Buteo lineatus	Red-shouldered hawk	PR	
Buteo platypterus	Broad-winged hawk	T	
Circus cyaneus	Marsh hawk	WR	

BIRDS			
Species	**Common Name**	**Status**	**Habitat**
Falco columbarius	Pigeon hawk	WR	
Falco sparverius	Sparrow hawk	WR	
Chordeiles minor	Common nighthawk	SR	
Falco peregrinus+	Peregrine falcon	T	
Colinus virginianus	Bobwhite	PR	MPH, RC
Rallus elegans	King rail	T	
Rallus longirostris	Clapper rail	PR	
Rallus limicola	Virginia rail	T	
Coturnicops noveboracensis	Yellow rail	T	
Latterallus jamaicensis+	Black rail	T	
Porzana carolina	Sora	T	
Gallinula chloropus	Common gallinule	T	
Fulica americana	American coot	WR	
Haematopus palliatus	American oystercatcher	T	
Charadrius semipalmatus	Semipalmated plover	T	
Charadrius melodus+	Piping plover	T	
Charadrius wilsonia	Wilson's plover	T	
Squatarola squatarola	Black-bellied plover	T	
Charadrius vociferus	Killdeer	PR	
Arenaria interpres	Ruddy turnstone	T	
*Philohela minor**	American woodcock	WR	MPH
Capella gallinago	Common snipe	WR	MPH
Numenius phaeopus	Whimbrel	T	
Actitis macularia	Spotted sandpiper	T	
Tringa solitaria	Solitary sandpiper	T	
Micropalama himantopus	Stilt sandpiper	T	
Ereunetes pusillus	Semipalmated sandpiper	T	
Ereunetes mauri	Western sandpiper	T	
Erolia maritima	Purple sandpiper	WR	
Erolia melanotos	Pectoral sandpiper	T	
Erolia fuscicollis	White-rumped sandpiper	T	
Erolia minutilla	Least sandpiper	T	
Catoptrophorus semipalmatus	Willet	T	
Totanus melanoleucus	Greater yellowlegs	T	
Totanus flavipes	Lesser yellowlegs	T	
Calidris canutus	Knot	T	
Erolia alpina	Dunlin	T	
Limnodromus griseus	Short-billed dowitcher	T	
Crocethia alba	Sanderling	T	
Larus marinus	Great black-backed gull	WR	
Larus argentatus	Herring gull	WR	
Larus delawarensis	Ring-billed gull	WR	
Larus atricilla	Laughing gull	T	
Larus philadelphia	Bonaparte's gull	T	
Rissa tridactyla	Black-legged kittiwake	T	
Sterna nilotica+*	Gull-billed tern		
Sterna forsteri+	Forster's tern	T	
Sterna hirundo	Common tern	T	
Sterna albifrons+	Least tern	SR	
Thalasseus maximus	Royal tern	T	
Hydroprogne caspia+	Caspian tern	T	

BIRDS			
Species	**Common Name**	**Status**	**Habitat**
Chlidonias niger	Black tern	T	
Zenaidura macroura	Mourning dove	PR	MPH, RC
*Columba livia**	Rock dove		
Coccyzus americanus	Yellow-billed cuckoo	SR	
Coccyzus erythropthalmus	Black-billed cuckoo	T	
Tyto alba+	Barn owl	PR	
Otus asio	Screech owl	PR	
Bubo virginianus	Great horned owl	PR	
Strix varia	Barred owl	PR	
Asio flammeus	Short-eared owl	WR	
Caprimulgus vociferous	Whip-poor-will	T	
Chaetura pelagica	Chimney swift	SR	
Archilochus colubris	Ruby-throated hummingbird	SR	RC
*Megaceryle alcyon**	Belted kingfisher	PR	
Colaptes auratus	Flicker	PR	MPH, PF
Dryocopus pileatus picinus	Pileated woodpecker	PR	
Centurus carolinus	Red-bellied woodpecker	PR	MPH, PF
Melanerpes erythrocephalus	Red-headed woodpecker	PR	
Dendrocopus villosus	Hairy woodpecker	PR	
Dendrocopus pubescens	Downy woodpecker	PR	MPH, PF, RC
Sphyrapicus varius	Yellow-bellied sapsucker	WR	
Tyrannus tyrannus	Eastern kingbird	SR	
Myiarchus crinitus	Great crested flycatcher	SR	
Empidonax virescens	Acadian flycatcher	SR	
Sayornis phoebe	Eastern phoebe	SR	
*Contopus virens**	Eastern wood pewee	SR	
Eremophila alpetris	Horned lark	WR	
*Iridoprocne bicolor**	Tree swallow	T	
Stelgidopteryx ruficollis	Rough-winged swallow	SR	
Hirundo rustica	Barn swallow	SR	
Progne subis	Purple martin	SR	
Cyanocitta cristata	Blue jay	PR	MPH, PF, RC
Corvus brachyrhynchos	Common crow	PR	RC
Corvus ossifragus	Fish crow	SR	RC
Parus carolinensis	Carolina chickadee	PR	MPH, PF, RC
Parus bicolor	Tufted titmouse	PR	MPH, PF, RC
Sitta carolinensis	White-breasted nuthatch	PR	MPH, RC
Sitta canadensis+	Red-breasted nuthatch	WR	
Sitta pusilla	Brown-headed nuthatch	PR	PF
Certhia familiaris+	Brown creeper	WR	PF
Troglodytes aedon	House wren	SR	MPH, RC
*Cistothorus palustris**	Marsh wren		
Troglodytes troglodytes+	Winter wren	WR	
Thryothorus ludovicianus	Carolina wren	PR	MPH, PF, RC
Telmatodytes palustris	Long-billed marsh wren	SR	
Cistothorus platensis	Short-billed marsh wren	T	
Mimus polyglottus	Mockingbird	PR	MPH, RC
Dumetella carolinensis	Catbird	SR	MPH, RC
Toxostoma rufum	Brown thrasher	SR	MPH, PF, RC
Turdus migratorius	Robin	SR	MPH, RC
Hylocichla mustelina	Wood thrush	SR	

BIRDS			
Species	**Common Name**	**Status**	**Habitat**
Hylocichla guttata+	Hermit thrush	WR	MPH
Hylocichla ustulata	Swainson's thrush	T	
Hylocichla minima	Gray-checked thrush	T	
Seiurus noveboracensis	Northern waterthrush	T	
Seiurus motacilla	Louisiana waterthrush	T	MPH
Hylocichla	Veery	T	MPH, RC
*Sialia sialia**	Eastern bluebird	PR	
Polioptila caerulea	Blue-gray gnatcatcher	SR	RC
Regulus satrapa	Golden-crowned kinglet	WR	MPH, PF
Regulus calendula	Ruby-crowned kinglet	WR	MPH, PF, RC
Anthus spinoletta	Water pipit	WR	
Bombycilla cedrorum	Cedar waxwing	WR	MPH, RC
Lanius ludovicianus+	Loggerhead shrike	WR	
Strurnus vulgaris	Starling	PR	
Vireo griseus	White-eyed vireo	SR	RC
Vireo flavifrons	Yellow-throated vireo	SR	
Vireo solitarius	Solitary vireo	T	
Vireo olivaceus	Red-eyed vireo	SR	
*Vireo philadelphicus**	Philadelphia vireo		
Vireo gilvus	Warbling vireo	T	
Mniotilta varia	Black and white warbler	SR	MPH, RC
Vermivora peregrina	Tennessee warbler	T	
Parula americana	Parula warbler	SR	PF
Dendroica petechia	Yellow warbler	SR	
Dendroica magnolia+	Magnolia warbler	T	
Dendroica tigrina	Cape May warbler	T	
Dendroica caerulescens	Black-throated blue warbler	T	
Dendroica coronata	Myrtle warbler	WR	MPH, PF, RC
Dendroica virens	Black-throated green warbler	T	
Dendroica dominica	Yellow-throated warbler	SR	PF
Dendroica pensylvanica	Chestnut-sided warbler	T	
Dendroica striata	Blackpoll warbler	T	
Dendroica pinus	Pine warbler	PR	PF
Dendroica discolor	Prairie warbler	SR	
Dendroica palmarum	Palm warbler	T	PF
*Protonotaria citrea**	Prothonotary warbler		
*Vermivora pinus**	Blue-winged warbler		
*Helmitheros vermivorus**	Worm-eating warbler		
*Vermivora ruficapilla**	Nashville warbler		
Wislonia citrina	Hooded warbler	SR	
Wilsonia pusilla	Wilson's warbler	T	
Wilsonia canadensis	Canadian warbler	T	
Seiurus aurocapillus	Ovenbird	SR	
Geothlypis trichas	Yellowthroat	SR	MPH, PF, RC
Iceteria virens	Yellow-breasted chat	SR	
Setophaga ruticilla	American redstart	T	MPH
Dolichonyz oryzivorus	Bobolink	T	
Sturnella magna	Eastern meadowlark	PR	
Agelaius phoeniceus	Red-winged blackbird	PR	RC
Euphagus corlinus	Rusty blackbird	WR	MPH
Icterus spurius	Orchard oriole	SR	

BIRDS			
Species	**Common Name**	**Status**	**Habitat**
Icterus gallbula	Baltimore oriole	T	
Cassidix mexicanus	Boat-tailed grackle	SR	
Quiscalus quiscula	Common grackle	PR	MPH, PF, RC
*Molothrus ater**	Brown-headed cowbird	PR	MPH, PF
Piranga olivacea	Scarlet tanager	T	
Piranga rubra	Summer tanager	SR	
Richmondena cardinalis	Cardinal	PR	MPH, PF, RC
*Cardinalis cardinalis**	Northern cardinal		
Pheucticus ludovicinaus	Rose-breasted grosbeak	T	
Guiraca caerulea	Blue grosbeak	SR	
Hesperiphona verpentina	Evening grosbeak	WR	
Passerina cyanea	Indigo bunting	SR	
Plectrophenax nivalis	Snow bunting	WR	
Carpodacus purpureus+	Purple finch	WR	
*Carpodacus mexicanus**	House finch		
*Spinus tritiss**	American goldfinch	PR	MPH, PF RC
Spinus pinus	Pine siskin	WR	
Pipilo erythrophthalmus	Rufous-sided towhee	PR	MPH, PF, RC
Passerculus sandwichensis	Savannah sparrow	WR	MPH
Ammospiza caudacuta+	Sharp-tailed sparrow	PR	
Ammospiza martima	Seaside sparrow	SR	
Pooecetes gramineus	Vesper sparrow	T	
*Ammodramus savannarum**	Grasshopper sparrow		
*Ammodramus henslowii**+	Henslow's sparrow		
Spizella arborea	Tree sparrow	WR	
Passer domesticus	House sparrow	PR	
Spizella passerina	Chipping sparrow	SR	
Spizella pusilla	Field sparrow	PR	MPH, RC
Zonotrichia leucophrys	White-crowned sparrow	WR	
Zonotrichia albicollis	White-throated sparrow	WR	MPH, PF, RC
Passerella iliaca	Fox sparrow	WR	
Melospiza georgiana	Swamp sparrow	WR	MPH, RC
*Melospiza melodia**	Song sparrow	PR	MPH, PF, RC
Junco hyemalis	Slate-colored junco	WR	
*Haliaeetus leucocephalus**+	Bald eagle		
*Pandion haliaetus**	Osprey		
*Falco sparverius**	American kestrel		
*Pelicanus occidentalis**	Brown pelican		
*Phasianus colchicus**	Ring-necked pheasant		
*Parula americana**	Northern parula		

* *Note*: These species were identified/collected at LaRC during ODU's 1994 biological survey
+ *Note*: These species are either Federal- or State-listed as endangered, threatened, or special concern species, 1998.

MAMMALS			
Species	**Common Name**	**Status**	**Habitat**
1. Species which occur both north and south of Hampton Roads			
Didelphis marsupialis virginiana	Opossum	C	G
Sorex longirostris longirostris	Southeastern shrew	U	S, A
Cryptotis parva parva	Least shrew	C	M, S, A
Blarina brevicanda carolinensis	Short-tailed shrew	A	HF, MPH, PF, AF, S
Scalopus aquaticus aquaticus	Eastern mole	A	D, A, PF
Condylura cristata cristata+	Star-nosed mole	U	AF, M
Myotis lucifugus lucifuguss	Little brown bat	A	HF, MPH, AF, PF, D, OW
Myotis keenii septentrioralis	Keen's bat	C	HF, MPH, AF, PF, OW
Lasionycteris noctivigans	Silver-haired bat	C	HF, AF, OW
Pipistrellus subflavus subflavus	Eastern pipistrelle	C	HF, MPH, AF, PF, D, OW
Eptesicus fuscus fucus	Big brown bat	U	HF, MPH, AF, PF, D, OW
Lasiurus borealis borealis	Red bat	A	HF, MPH, AF, PF, D, OW
Procyon lotor lotor	Raccoon	A	G
Mustela frenata noveboracensis	Long-tailed weasel	U	HF, AF, MPH, A, S
Mustela vison mink	Mink	U	AF, M, OW
Lura canadensis lataxina+	River otter	U	AF, M, OW
Vulpes fulva fulva	Red fox	U	HF, MPH, PF, S, A
Urocyon cinereoargenteus cinereoargenteus	Gray fox	C	HF, MPH, PF, A, S
Phoca vitulina concolor	Harbor seal	R (vagrant)	OW
Sciurus carolinensis carolinensis	Gray squirrel	A	HF, MPH, AF, D
Glaucomys volans volans	Southern flying squirrel	C	PF, MPH, AF, AF, D
Reithrodontomys humulis virginianus	Harvest mouse	C	S, A, M
Peromyseus leucopus leucopus	White-footed mouse	A	HF, MPH, AF, S, M, A
Oryzomys palustris palustris	Rice rat	A	M, S, A
Microtus pennsylvanicus pennsylvanicus	Meadow vole	C	A, S, AF (Bogs)
Microtus pinetorum scalopsoides	Pine vole	U (local)	A, S, PF
Ondatra zibethicus macrodon	Muskrat	A	M, OW
Rattus norvegicus	Norway rat	A	D, M, S, A
Mus musculus brevirostris	House mouse	A	D, M, S, A
Sylvilagus floridanus	Eastern cottontail	A	G
Odocoileus virginianus virginianus	White-tailed deer	C	G
2. Species which occur at LaRC, as found in distributional data from Webster, et al. (1985), Rose and Cranford (1987), and Rose (personal communication).			
Sylvilagus palustris+	Marsh rabbit		
Peromyscus gossypinus	Cotton mouse		
Ochrotomys nuttalli	Golden mouse		
Myocaster coypus	Nutria		
+ *Note*: These species are either Federal- or State-listed as endangered, threatened, or special concern, 1998.			

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APPENDIX V-2

AQUATIC SPECIES COLLECTED IN THE NASA LANGLEY RESEARCH CENTER AREA

Notes:

Collection sites
a - Mouth of Brick Kiln Creek
b - Cedar Point area
c - Tabbs Creek mouth
d - Back River channel
e - Channel between Tabbs Point and Tin Steel Point
f - Area adjacent to the stave south of Tabbs Point
g - Shallows between Stoney point and Mears
h - Back Landing

Months
A - April sample
J - June sample
S - September sample

1. Species caught within the Northwest Branch of the Back River and its contiguous creeks (ODU, 1995).

Species	Common Name	Site							
		a	b	c	d	e	f	g	h
Chasmodes bosquianus	Striped blenny					A			
Trinectes maculatus	Hogchoker	A, J, S	A	A, J, S	A, S	A, J, S	A	A, J	A, J
Cynoscion regalis	Weakfish	J, S		J, S		A, S		A	
Opsanus tau	Oyster toadfish	A		A, J, S	A, S	A		J	
Bairdiella chrysoura	Silver perch	A, J, S	A, S	A, S		A, J			
Urophycis regia	Spotted hake					A			
Leiostomus xanthurus	Spot	A, J, S	A, S	A, J, S	A, S	A, J, S	A, S	A, S	A, S
Micropogonias undulatus	Atlantic croaker	A	A	A	A	A, J	A, S	A	A
Paralichthys dentatus	Summer flounder			A		A, J			
Morone saxatilis	Striped bass	A, J	A	J	S				
Anchoa mitchelli	Bay anchovy	A, J, S	A, J, S	A, J, S	A, S	A, J, S	A, S	A, J, S	A, J, S
Microgobius thalassinus	Green goby					A			
Gobiosoma bosc	Naked goby					A, S			
Caranx hippos	Crevalle jack				S				J
Lagodon rhomboides	Pinfish							J	
Menidia menidia	Atlantic silverside		A, J	A, J	A, J				
Tautoga onitis	Tautog				S		A		
Orthopristis chrysoptera	Pigfish		S	S	S	S		J, S	
Sygnathus fuscus	Northern pipefish							J	
Pomatomas	Bluefish						J, S		

1. Species caught within the Northwest Branch of the Back River and its contiguous creeks (ODU, 1995).

Species	Common Name	Site							
		a	b	c	d	e	f	g	h
saltarix									
Peprilus triacanthus	Butterfish			J					
Prionotus carolinus	Northern sea robin						S		
Chaetodipterus faber	Atlantic spadefish	S	S						
Menticirrhus americanus	Southern kingfish	S	S						
Selene vomer	Lookdown	S	S						
Anguilla rostrata	American eel			J					
Brevoortia tyrannus	Menhaden			J					

Notes: Drainages, Marshes, and Ponds associated with Brick Kiln Creek

1 - Pond: permanent pond in northwest corner of LaRC property
2 - Marsh: brackish tidal marsh surrounding Site 1
3 - Marsh Creek: natural tidal creek draining portions of Site 2
4 - Marsh: south of 12 Wythe Landing Loop (WLL), adjacent to Bldg 1258 (WLL)
5 - Pond: semi-permanent pond east of Garrett-Winder Cemetary
6 - Drainage: drainage ditch system originating in the forest on the west side of LaRC, emptying into Brick Kiln Creek
7 - Drainage: brackish tidal creeks emptying into Brick Kiln Creek behind Bldg 1157
8 - Drainage: small drainage area west of 20 Hunsaker Loop

Tabbs Creek Feeder Drainage

9 - Drainage: large freshwater drainage ditch east of Doolittle Rd, north of softball fields

Drainage Stream

10 - Stream: intermittent stream crossing the tract of pine woods in the southeast corner of LaRC property

2. Species caught within the fresh and brackish drainages and ponds on NASA/LAFB property (ODU, 1995).

Species	Common Name	Site									
		1	2	3	4	5	6	7	8	9	10
Fundulus heteroclitus	Mummichog							A, J, S			
Fundulus majalis	Striped killifish	A, J, S	A, J, S	A, J, S			A, J, S	A, J, S		A, J, S	
Lucanis parva	Rainwater killifish	A, J, S	A, J, S	A, J, S			A, J, S	A, J, S		A, J, S	
Gambusia affinis	Mosquitofish	A, J, S	A, J, S	A, J, S			A, J, S			A, J, S	
Anguilla rostrata	American eel						A				
Menidia beryllina	Inland silverside	A, J, S									
Lepomis macrochirus	Bluegill	A									

3. Benthic invertebrate species collected at NASA LaRC during October 1994 (ODU, 1995).			
Phylum	**Tabbs Creek**	**Back River**	**Brick Kiln Creek**
Annelida	Class Polychaeta *Nereis spp*. Class Oligochaeta *Oligochaeta spp*.	Class Polychaeta *Glycinde solitaria* *Haploscolopus fragilis* *Heteromastus filiformis* *Nereis succinea* *Spiochaetopterus oculatus* Class Oligochaeta *Oligochaeta spp*.	Class Polychaeta *Nereis succinea*
Arthropoda	Class Crustacea *Cyathura polita*	Class Crustacea *Corophium spp.* *Lepthocheirus plumulosus* *Leptalpheus forceps*	Class Crustacea *Uca minax*
Nemertina		Class Nemertina *Nemertina spp*.	

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Exhibit I
Amendments to the NASA Langley Research Center
Environmental Resources Document

CHANGE			
No.	**Date**	**Pages or Sections Replaced**	**Reason**
1	June 2001	Description of Center	Update the following Tables: 1-1 Major Facilities at NASA LaRC 1-2 Tenant Organizations at NASA LaRC
2	June 2001	Air Resources	Update all tables with CY2000 data. Update regulatory requirements. Moved list of hazardous air pollutants from chapter, created Appendix II-1
3	June 2001	Land Resources	QA regulations and LaRC policies to ensure references are correct. Add brief comment about the 35 million year old crater that was discovered in the Chesapeake Bay area.
4	June 2001	Endangered Species	Update endangered and threatened species list as needed.
5	June 2001	Insecticides & Herbicides	Verify chemical usage.
6	June 2001	Historic, Archaeological, and Cultural Resources	QA regulations and LaRC policies to ensure references are correct.
7	June 2001	Community Relations & Local Economy	Update *13.2, 13.3* and *13.4* to reflect most recent Census data; update all other sections with current figures. Remove Minority and Poverty Level maps.
8	June 2001	Noise & Vibration	Verify sources and references.
9	June 2001	Energy	Update energy consumption to reflect FY 2000 data.
10	June 2001	EPCRA/CERCLA	Update TRI data in Table 16-1. Update LaRC NPL Sites in Table 16-2.

Exhibit I
Amendments to the NASA Langley Research Center Environmental Resources Document

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Exhibit II
NASA Langley Research Center
Preliminary Environmental Survey

Instructions: Complete form and forward to NASA LaRC Environmental Officer. See attached instructions for additional information.

SECTION I - PROJECT DESCRIPTION		
a. Project Title:		b. Control Number:
c. Date of Survey:	d. Contact Person/Code:	e. Estimated Dates: __/__/__ Construction Start __/__/__ Activation Start
f. Description of Proposed Action or Existing Activity (attach NASA form 1509 or equivalent and process flow diagram):		
g. Location of Proposed Action/Existing Activity: _____Name of USGS Quadrangle _____Section _____Township _____Range; __º__'__" N Latitude; __º__'__" W Latitude Alternate Coordinate System: _____		
h. Type of Facility (check) _____ Modification or expansion of existing _____New construction _____Existing	i. Estimated land area required (include units) _____	j. Estimated number of employees _____ Construction _____ Permanent
k. Estimated cost of proposed action/existing activity: Fund Source_____ $_____Total Cost $_____Construction Payroll $_____Annual Operation Payroll		
l. Estimated Operating Schedule: _____Hours per Day _____ Days per week _____Weeks per year		
m. Anticipated Life of Project: _____Years		

*** - See instruction page for definitions**

NASA LaRC Form_____

Exhibit II
NASA Langley Research Center
Preliminary Environmental Survey

	Yes	No	Unknown	If Yes, Type & Amount and/or Code	Environmental Office Use
SECTION II - AIR					
Does the activity:					
1. Use fuel-burning equipment?*					
2. Store and/or consume any solid material?					
3. Store and/or use any gaseous, pressurized or liquid chemical?*					
4. Use CFCs, halons, methyl chloroform or carbon tetrachloride?					
5. Produce any particular emissions?					
6. Use any particular emissions control equipment?*					
7. Produce any gaseous emissions?					
8. Use any gaseous emission control equipment?*					
9. Use any on-site disposal systems?*					
10. Use any pneumatic conveying system?					
11. Involve the removal of asbestos containing material?					
12. Involve sand blasting or media blasting of any structure or vessel?					
SECTION III - WATER					
Does the activity:					
1. Use existing sewage treatment?					
2. Require new sewage treatment processes?*					
3. Require water for process operation other than for drinking water and/or sanitation?*					
4. Use non-contact or contact cooling water?					
5. Require additional withdrawal of surface or groundwater?					
6. Discharge process wastewater?					
7. Use water transportation?					
8. Involve steam cleaning or water blasting of any structure or vessel?					
9. Require a location on or with direct access to a river, lake, stream, canal, or other body water?					

NASA LaRC Form_____

Exhibit II
NASA Langley Research Center
Preliminary Environmental Survey

	Yes	No	Unknown	If Yes, Type & Amount and/or Code	Environmental Office Use
10. Store bulk gasoline, diesel, or liquid chemicals? If so, above or underground storage?					
11. Will process area stormwater runoff be controlled by diversion, storage and controlled release or other methods?					
SECTION IV - LAND/WETLANDS					
1. Will any land area proposed for use require clearing, site grading, excavation, dredging, filling, and/or construction of docks, piers, or dolphins?					
2. Is the proposed land use consistent with NASA LaRC's Master Plan?					
3. Will any part of the facilities and/or support be located in or adjacent to floodplains, wetlands, or waterbodies?					
SECTION V - RADIOACTIVE MATERIALS AND NONIONIZING RADIATION					
1. Will the proposed action or existing activity use or introduce any new sources of ionizing or nonionizing radiation?					
SECTION VI - NOISE AND VIBRATION					
1. Will the proposed action or existing activity create noise/vibration?					
SECTION VII - TRANSPORTATION AND UTILITY CORRIDORS					
Will proposed action require:					
1. New roads and/or utility service teams?					
2. Any extensions and/or modifications to NASA LaRC's existing utility systems?					
SECTION VIII - SOLID AND HAZARDOUS WASTE					
Will proposed action or does the activity:					
1. Use or store chemicals at the facility?					
2. Generate any solid or liquid wastes?*					
If yes, any known hazardous waste?					
non-hazardous waster?					
3. Involve treatment, storage, and/or disposal operations?					
4. Have any chemical recycling equipment?					

NASA LaRC Form_____

Exhibit II
NASA Langley Research Center
Preliminary Environmental Survey

	Yes	No	Unknown	If Yes, Type & Amount and/or Code	Environmental Office Use
5. Have maintenance area at the location?					
SECTION IX - TOXIC SUBSTANCES					
1. Will the proposed action involve the use of PCB-containing equipment, asbestos containing material or will existing asbestos containing materials be disturbed?*					
SECTION X - PROPELLANTS AND EXPLOSIVES					
Will proposed activity or existing activity:					
1. Use any propellants or explosives?					
2. Generate waste propellant or waste explosives?					
REMARKS/ADDITIONAL INFORMATION					
Printed Name of Person Completing the Form_____					
Signature of Person Completing the Form_____				Telephone Number_____	

NASA LaRC Form_____

Exhibit II
NASA Langley Research Center
Preliminary Environmental Survey

INSTRUCTIONS FOR COMPLETING SURVEY FORM

The purpose of this form is to assist the NASA LaRC Environmental Office in the early identification of any project that may require evaluation under the National Environmental Policy Act (NEPA). Once NEPA compliance needs are identified then evaluation is more likely to be made in a timely and cost-effective manner. Please attach NASA Form 1509 or equivalent to this form along with block flow diagrams for proposed processes and location map (if applicable). Instructions follow for each section of the Preliminary Environmental Survey Form. Please contact the NASA LaRC Environmental Officer if you have any questions.

SECTION I - PROJECT DESCRIPTION

Item a. Self explanatory.

Item b. Use control number from Form 1509 NASA LaRC or Environmental Office with assign this number.

Item c. Fill in the date of this Preliminary Environmental Survey.

Item d. Enter the name of the person (and their NASA LaRC code) who is familiar with the proposed action.

Item e. Self explanatory.

Item f. Self explanatory.

Item g. Location should include the name of the USGS quadrangle map used, section, township, and range of the proposed action, and approximate latitude/longitude or attachment map if available.

Item h. Self explanatory.

Item i. Self explanatory.

Item j. An estimate is needed of the average number of new (not current) employees expected to be needed during construction and once the project has attained steady-state operation.

Item k. An estimate is needed of the: 1) total cost of the project and its funding source, 2) total construction payroll, and 3) annual payroll once the project has attained steady-state operation.

Item l. An estimate of the steady-state operating schedule is needed.

Item m. Self explanatory.

The remainder of this form has been organized to that if a given question applies, a mark should be placed in the "yes" column and requested details given. If the response to a given question is "yes" then give additional details under the column "if yes, type and amount and/or code". If the question does not apply, mark "no". If the correct response is not known, mark "unknown". Some tables of examples are given by section. Codes are given in each table to assist in conveying detailed information. Codes are numbered by corresponding question numbers. Enter all applicable codes under the column heading "if yes, type and amount and/or code".

NASA LaRC Form_____

Exhibit II
NASA Langley Research Center
Preliminary Environmental Survey

SECTION II - AIR

1. Examples of fuel burning equipment are given as follows. Please enter the code given for each type of equipment that will be used under the column heading, "If Yes, Type and Amount and/or Code".

Code	Type of Equipment
II-1-A	Boiler, natural gas
II-1-B	Boiler, other (specify)
II-1-C	Air heating for space heating, natural gas
II-1-D	Air heating for space heating, propane
II-1-E	Generator, gasoline
II-1-F	Generator, diesel
II-1-G	Generator, gas: Lox, H2
II-1-H	Generator, gas: other (specify)
II-1-I	Engine, cryogenic
II-1-J	Pilot system, natural gas
II-1-K	Pilot system, propane
II-1-L	Other (specify)

2. Examples of solid materials to be stored or used include coal, ash and/or process reagents.

3. Examples of gaseous, pressurized, or liquid chemicals that are already in use at NASA LaRC and, therefore, may apply to the proposed project are:

Code	Type of Gas or Liquid
II-3-A	Nitrogen
II-3-B	Helium
II-3-C	Hydrogen
II-3-D	Oxygen
II-3-E	Diesel Fuel
II-3-F	Gasoline
II-3-G	Lubricating Oil
II-3-H	Waste Oil
II-3-I	Ethylene Glycol
II-3-J	Acids
II-3-K	Caustics
II-3-L	Chemical cleaners
II-3-M	Solvents
II-3-N	Paints
II-3-O	Laboratory chemicals
II-3-P	Photographic chemicals
II-3-Q	Oxidizers
II-3-R	Pesticides/herbicides
II-3-S	Hydraulic fluids
II-3-T	RP-1
II-3-U	Hydrazine
II-3-V	Carbon Dioxide
II-3-W	Acetylene
II-3-X	Propane/Butane
II-3-Y	Other (Specify)

NASA LaRC Form_____

4. Examples of these chemicals that are currently in use at NASA LaRC and therefore, may apply to the proposed project are:

Code	Chemical
II-4-A	CFC-11
II-4-B	CFC-12
II-4-C	CFC-113
II-4-D	Halon 1211
II-4-E	Methyl chloroform

5. Self explanatory.

6. Examples of particulate emission control equipment are:

Code	Equipment Type
II-6-A	Cyclone
II-6-B	Water scrubber
II-6-C	Venturi scrubber
II-6-D	Electrostatic Precipitator
II-6-E	Baghouse
II-6-F	Other (Specify)

7. Examples of gaseous emissions include:

Code	Chemical
II-7-A	Sulfur oxides
II-7-B	Carbon monoxide
II-7-C	Nitrogen oxides
II-7-D	Volatile Organic Compounds
II-7-E	Fluorine
II-7-F	Chlorine
II-7-G	Benzene
II-7-H	Vinyl Chloride
II-7-I	Hydrogen Sulfide
II-7-J	Other (specify)

8. Examples of gaseous control equipment includes:

Code	Equipment Type
II-8-A	Water scrubber
II-8-B	Activated Carbon bed
II-8-C	Dry scrubber
II-8-D	Other (specify)

NASA LaRC Form_____

9. Examples of on-site treatment/disposal systems are:

Code	Equipment Type
II-9-A	Solid Waste incinerator
II-9-B	Liquid Waste incinerator
II-9-C	Waste fuel recovery burner
II-9-D	Gaseous flare
II-9-E	Other (specify)

10. Self explanatory.

11. Self explanatory.

12. Self explanatory.

SECTION III - WATER

1. Self explanatory.

2. Examples of new wastewater treatment processes are:

Code	Equipment Type
III-2-A	Biological (examples: septic tank, package plant)
III-2-B	Chemical/physical (examples: precipitation, filtration, ion exchange, activated carbon)
III-2-C	Other (specify)

3. Self explanatory.

4. For example, if water used for cooling coming in contact with product, then it becomes contact cooling water. If it does not come in contact with product, it is non-contact cooling water.

5. Self explanatory.

6. Process wastewater does not include non-contact cooling water or sanitary sewage.

7. Self explanatory.

8. Self explanatory.

9. Self explanatory.

10. Self explanatory.

11. Self explanatory.

SECTION IV - LAND/WETLANDS

1. Self explanatory.

2. Please refer to the NASA LaRC Master Plan for information relating to land use.

3. Please use the information contained in this Environmental Resource Document and consult with the NASA LaRC Environmental Office to determine proximity to floodplains and wetlands.

NASA LaRC Form_____

SECTION V - RADIOACTIVE MATERIALS AND NONIONIZING RADIATION

1. Examples of uses for ionizing radiation sources at NASA LaRC are for analysis, calibration, and nondestructive testing (radon, radionuclides). Nonionizing sources at NASA LaRC are currently limited to microwave radiation.

SECTION VI - NOISE AND VIBRATION

1. Self explanatory.

SECTION VII - TRANSPORTATION AND UTILITY CORRIDORS

1. Self explanatory.

2. Self explanatory.

SECTION VII - SOLID AND HAZARDOUS WASTE

1. Self explanatory.

2. Examples of hazardous waste currently generated at NASA LaRC are given in the following only as guidance in responding to this question.

Code	Hazardous Waste Generated
VIII-2-A	Spent solvents
VIII-2-B	Reaction products
VIII-2-C	Unused or expired agents
VIII-2-D	Acids
VIII-2-E	Bases
VIII-2-F	Test Sample wastes
VIII-2-G	Equipment cleaning wastes
VIII-2-H	Spent blast materials (paints)
VIII-2-I	Rinse water and containers from herbicide/pesticide use
VIII-2-J	Paint wastes
VIII-2-K	Ignitable wastes
VIII-2-L	Vehicle maintenance wastes
VIII-2-M	Photographic process wastes
VIII-2-N	Other (specify)

Examples of nonhazardous waste currently generated at NASA LaRC are given in the following only for guidance in responding to this question:

Code	Nonhazardous Waste Generated
VIII-2-O	Metals
VIII-2-P	Glass
VIII-2-Q	Wood
VIII-2-R	Paper
VIII-2-S	Plastic
VIII-2-T	Waste (used) oil
VIII-2-U	Other (specify)

3. Treatment of a hazardous waste means any process designed to change the physical, chemical or biological character or composition of a hazardous waste to neutralize it, recover energy or material resources from it, render it less hazardous or nonhazardous, safer to handle, or amenable to recovery, storage, or reduction in volume.

NASA LaRC Form_____

Storage means the holding of a hazardous waste for a temporary period, at the end of which the hazardous waste into or on any load or water so that such solid or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwater.

Disposal means the discharge, deposit, injection, dumping, spilling, leaking or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwater.

4. Self explanatory.

5. Self explanatory.

SECTION IX - TOXIC SUBSTANCES

1. The primary applicability of the Toxic Substances Control Act (TSCA) at NASA LaRC relates to the decommissioning and decontamination of PCB-contaminated equipment and the handling of asbestos-containing materials. Other chemicals regulated under TSCA include:

Code	Chemical
IX-1-A	Metalworking fluids containing mixed mono and dianides of an organic acid, thiethanolamine salt of a substituted organic acid and triethanolamine salt of a tricarboxylic acid.
IX-1-B	Hexavalent chromium chemicals in comfort cooling towers.
IX-1-C	Fully halogenated cholorofluoroalkanes for aerosol propellant use.
IX-1-D	Halogenated dibenzodioxins.dibenzofurans as contaminates in certain specified manufactured and processed chemical substances.

SECTION X - PROPELLANTS AND EXPLOSIVES

1. Self explanatory.

2. Self explanatory.

Once completed, please add any additional information, sign the form, fill in your telephone number, and forward to LaRC Environmental Office.

NASA LaRC Form_____